U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-257 589

Aspen Metro Sanitation District. Snowmass Water and Sanitation District. 201 Wastewater Facilities Plans

Weiner and Associates, Denver, Colo

Prepared for

Environmental Protection Agency, Denver, Colo Region VIII

Aug 76

PB 257 589

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET

1. Report No.

2.

3. Recipient's Accession No. PB-257 589

4. Title and Subtitle
Aspen Metro Sanitation District. Snowmass Water and Sanitation District. 201 Wastewater Facilities Plans

5. Report Date Aug 76

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Weiner and Associates
Denver, Colorado

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
Environmental Protection Agency
Denver, Colorado
Region VIII

13. Type of Report & Period Covered

14.

15. Supplementary Notes
Sponsored by Environmental Protection Agency, Denver, Colo. Region VIII.

16. Abstracts

The Region Administrator of the U.S. Environmental Protection Agency intends to provide federal matching funds for regional wastewater treatment in the combined Aspen and Snowmass Resort study areas within Colorado, through the authority of the Water Pollution Control Act (as amended, 1972). The purpose of this draft Environmental Impact Statement (EIS), required of federal agencies by the National Environmental Policy Act (NEPA, 1969) is to notify governmental agencies and the public at large of this impending project with potential environmental ramifications.

17. Key Words and Document Analysis. 17a. Descriptors

*Environmental impact statements - draft,
*Sewage treatment,
*Colorado,

Improvement,
Methodology,
Discharge,
Surface water runoff,
Facilities,
Expansion,
Project planning,
Land development,
Chlorine,
Recommendations,
Standards.

17b. Identifiers/Open-Ended Terms
*Aspen(Colorado),
*Snowmass Resort(Colorado),
Alternatives,
Sewage treatment plants,
Plant closings,
Land treatment,
Water pollution standards.

17c. COSATI Field/Group 13 B

18. Availability Statement
National Technical Information Service
Springfield, Virginia 22161

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 147p

22. Price 6.00/2.25

FORM NTIS-35 (REV. 10-73) ENDORSED BY ANSI AND UNESCO. THIS FORM MAY BE REPRODUCED USCOMM-DC 8265-P74

Draft Environmental Impact Statement

Aspen Metro Sanitation District
Snowmass Water & Sanitation District

201 Wastewater Facilities Plans

United States Environmental Protection Agency
Region VIII, Denver, Colorado

John A. Gr
Regional Admi

August 1976
Date

Prepared By:
Weiner & Associates, Denver, Colorado

SUMMARY

SHEET

Environmental

Impact

Statement

(x) DRAFT

( ) FINAL

Prepared for the U.S. Environmental Protection Agency, Rocky Mountain-Prairie Region, Region VIII, Denver, Colorado, through a contract with Weiner & Associates, Inc., Denver, Colorado.

A. **Type of Action:** (x) Administrative

( ) Legislative

B. Brief Description of Proposal

The Region VIII Administrator of the U.S. Environmental Protection Agency intends to provide federal matching funds for regional wastewater treatment in the combined Aspen and Snowmass Resort study areas within Colorado, through the authority of the Water Pollution Control Act (as amended, 1972). The purpose of this draft Environmental Impact Statement (EIS), required of federal agencies by the National Environmental Policy Act (NEPA, 1969) is to notify governmental agencies and the public at large of this impending project with potential environmental ramifications.

The principal river drainage is the Roaring Fork River which is in good condition but is threatened by increased future discharges from point (sewage plant) and nonpoint (runoff) sources. In addition, present point sources do not have the facilities to meet effluent concentrations for ammonia, residual chlorine and suspended solids as prescribed by discharge permits under the Act.

C. Alternatives Considered

Specific alternatives have only been proposed for domestic sewage treatment. Nonpoint source control remains an unresolved issue of this draft EIS. The alternatives utilize existing treatment plants for expanded activated sludge secondary treatment. Tertiary alternatives include advanced biological treatment options for ammonia control; mixed media filtration for suspended solids; and rock channel residual chlorine control. The latter approach presents a technical issue to be resolved because EPA feels that this technology will not achieve required limits.

Summertime land treatment has also been proposed for both study areas. In Aspen, this approach will utilize effluent nutrients and augment Salvation irrigation ditch water thereby eliminating the need for total legal diversion. Diversion has, in the past, dried up a two-mile section of the Roaring Fork during low flow periods. In Snowmass, land treatment is proposed because it would achieve required treatment levels in the summer which are beyond the capabilities of in-plant biological systems.

D. Environmental Impacts

The proposed facilities protect the Roaring Fork and Brush Creek, in the case of Snowmass from deterioration resulting from increased point source discharges. In Aspen it is recommended to close the older of the two existing plants — the Aspen Sanitation District (ASD) plant. This conforms to citizen preference and is the only practical cost-effective means of complying with water quality discharge standards. An existing connecting outfall sewer would allow for 1977 retirement of this plant and corresponding expansion at the Aspen Metro District Plant 4.8 km downstream from the ASD plant. Net 1977 increase in Aspen capacity (0.5 million gallons per day (mgd)) will be minimal, therefore, this 201 project is not considered a growth stimulant. In Snowmass, capacity will be increased in 1977 from 0.8 to 1.6 mgd which will accomodate growth needed for the financial well-being of the resort village and the Snowmass Water and Sanitation District. This expansion is not considered an adverse growth inducement. Area property costs and county land use regulation will control development as reflected in the widely accepted population projections developed for this EIS and the Facilities Plans. Therefore, the unresolved issues for which remedial measures will be developed prior to issuance of the final EIS include:

- Development of structural and non-structural (policy) plans for the control of nonpoint sources, deemed necessary to comply with the intent of the Act.
- Negotiations with specific land owners for summertime land treatment on designated sites.
- Acceptable treatment approach for residual chlorine.

E. Distribution

The draft EIS is being provided to the following.

Local Agencies:

Pitkin County Planning Department
Pitkin County Board of Commissioners
Pitkin County Environmental Health Department
City of Aspen Planning Department
City of Aspen Engineering Department

Local Agencies (continued):

Aspen City Council
201 Citizen Advisory Committee Members
Aspen Sanitation District
Aspen Metro Sanitation District
Snowmass Water and Sanitation District
Snowmass Resort Association
West Village Association
Aspen Valley Improvement Association
Northwest Colorado Council of Governments

State Agencies:

State Clearinghouse/Division of Planning will distribute copies to appropriate state agencies including the following:
- Colorado Water Pollution Control Division
- Colorado Air Pollution Control Division
- Colorado State Board of Land Commissioners
- Colorado State Land Use Commission
- Colorado Division of Highways
- Colorado Division of Wildlife
- Colorado Department of Natural Resources/Water Resources Division
- Colorado Historical Society

Federal Agencies:

Forest Service (White River National Forest)
Federal Highway Commission
U.S. Bureau of Reclamation
Bureau of Outdoor Recreation
U.S. Fish and Wildlife Service
Bureau of Land Management
Field Representative, Office of the Secretary of Interior
Soil Conservation Service (local and regional offices)
U.S. Geological Survey
Economic Development Administration
U.S. Senators Hart and Haskell
U.S. Representatives Armstrong, Evans, Johnson, Schroeder, Wirth
Federal Energy Office
U.S. Public Health Service
U.S. Department of Housing and Urban Development.
Urban Mass Transit Administration

Others:

Colorado Open Space Council, Inc.
Trout Unlimited
National Wildlife Federation
Rocky Mountain Center on Environment
Wright-McLaughlin Engineers
Denver Post
Rocky Mountain News
Aspen Times
Aspen Chamber of Commerce
Snowmass Corporation
Aspen Highlands Ski Corporation
Aspen Skiing Corporation
League of Women Voters
Special Districts Association of Colorado
Colorado Municipal League

F. Acknowledgements

Many people were helpful in the preparation of this EIS, and it is not possible in a limited space to acknowledge all of them. We would like to give special thanks to the administrative

staff of the City of Aspen, the staff of the Pitkin County Planning Department, Wright-McLaughlin Engineers, and the concerned citizens of Pitkin County.

TABLE OF CONTENTS

Page

SUMMARY SHEET ii

SUMMARY S-1
  Why Additional Facilities? S-1
  The EIS Role S-1
  Facilities Plans S-3
  The Problem and the Plan S-3

I. WATER ENVIRONMENT 1
  Water Quality and Quantity 3
  Wastewater Discharges and Existing Treatment Facilities 20
  Nonpoint Source Runoff 32
  Water System Management 36

II. OTHER EXISTING ENVIRONMENTS 39
  Natural Environment 39
    Geology 39
    Soils 40
    Biology 43
    Climate 45
    Air Quality 45
  Man-Made Environment 48
    Socio-economics 48
    Population and Land Use 50
    Financial Conditions of the Districts 59
    History, Archaeology, and Aesthetics 61
    Public Recreation 62
    Transportation 63
    Noise 64
    Other Federal Projects 65

Page

III. DESCRIPTION OF THE PROPOSED ALTERNATIVES 67
  Aspen Alternatives 67
  Snowmass Alternatives 70

IV. EVALUATION OF THE ALTERNATIVES 75
  Water Quality 75
  Geology 93
  Soils 93
  Biology 93
  Climatology and Air Quality 94
  Land Use 95
  Population and Growth 96
  Costs 97
  Citizen Preference 101

V. RECOMMENDED ACTION 105
  Aspen Study Area 105
  Snowmass Study Area 105

VI. MITIGATION MEASURES 109
  Water Quantity 109
  Water Quality 109
  Geology 110
  Soils 110
  Biology 111
  Air Quality 111
  History and Archaeology 111
  Conclusion 111

VII. UNAVOIDABLE ADVERSE EFFECTS 113

VIII. SHORT TERM USES AND LONG TERM PRODUCTIVITY 114

TABLE OF CONTENTS

Page

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES 115

BIBLIOGRAPHY 116

APPENDIX A A-1

APPENDIX B B-1

APPENDIX C C-1

I.

WATER ENVIRONMENT

The important surface waters in the project area are the Roaring Fork River and some of its tributaries (Figure D). The Roaring Fork originates near Independence Pass and flows northwest to Glenwood Springs, where it joins the Colorado River. As it flows through Aspen, it picks up Hunter Creek from the north, then Castle, Maroon, Owl and Brush Creeks from the south. Brush Creek is a minor tributary to the Roaring Fork, but receives all the secondary effluent from Snowmass Water and Sanitation District. The Roaring Fork itself receives effluent from the Aspen Metro Sanitation District and the Aspen Sanitation District. These two waterways receive the emphasis in this chapter although the others are also discussed.

The water quality of the area's surface waters is excellent and provides a healthy environment for fish and other aquatic life. State standards are adhered to for general stream quality and are usually adhered to for sewage discharges. Exceptions include periodic violations of Snowmass's discharges, which sometimes have high values for residual chlorine and suspended solids. The receiving water for this discharge, Brush Creek, also has high levels of suspended solids although this condition does not violate any legal standard. Furthermore, this waterway supports a brown and brook trout fishery and has done so for many years.

Despite governmental attempts to control water quality by controlling point sources of discharge, other sources also degrade stream quality. These sources, called nonpoint sources, are calculated to contribute more suspended solids on an annual basis to the area's streams than the sewage discharges. Nonpoint sources also contribute a large portion of the organic material (BOD) that is discharged into these streams. Their eventual control is necessary for the maintenance of area's water quality.

The flows of the Roaring Fork River and Brush Creek are usually sufficiently large to receive discharged effluents from the project's three existing plants. However, Brush Creek provides little flow in the fall and the Roaring Fork has been essentially dry on occasion at the Mill Street plant (The Aspen Times, Fall 1974).

These factors and others are discussed in the text that follows. Major topics include institutional goals and constraints, existing surface water quality and quantity, existing groundwater quality, and quantity wastewater discharges and existing treatment facilities, nonpoint source runoff and water supply and management. Those aspects that directly affect

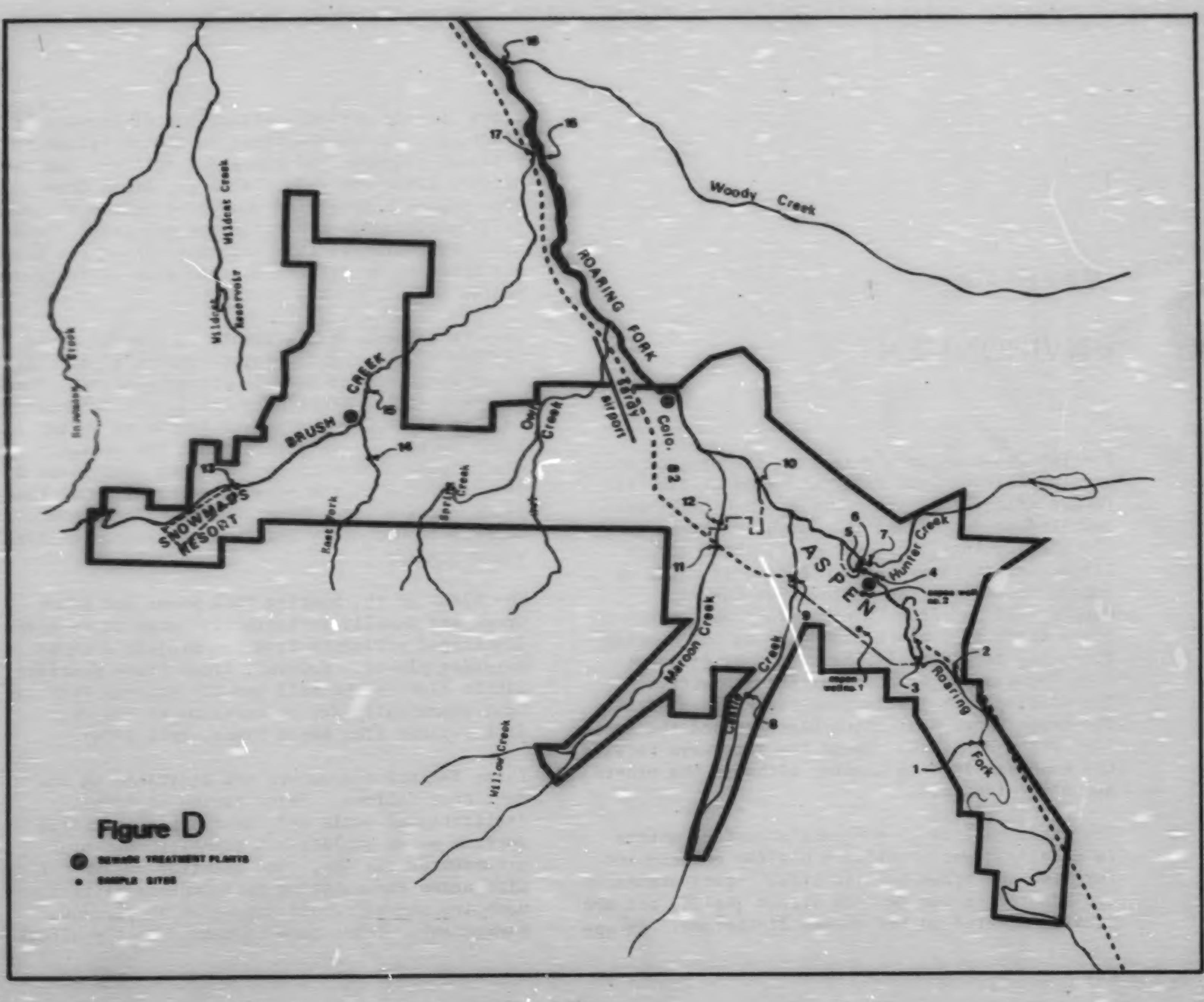


Figure D

SEWAGE TREATMENT PLANTS
SAMPLE SITES
ASPEN
Roaring Fork
ROARING FORK
Hunter Creek
Castle Creek
Maroon Creek
Willow Creek
Woody Creek
Colo. 82
Sardy airport
Owl Creek
Spring Creek
East Fork
BRUSH CREEK
SNOWMASS RESORT
Wildcat Creek
Wildcat Reservoir
Snowmass Creek
aspen well no. 1
aspen well no. 2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

the projects are emphasized.

WATER QUALITY AND QUANTITY

This section sets forth the goals and institutional constraints that are imposed on the aquatic environment of the project area. Some of these constraints are legally effective now, while others are not effective until future dates. However, both types of constraints will be considered in the final design of the expanded treatment facilities. The background quality and quantity of the surface waters is also discussed in this section and compared with institutional constraints and recommendations. The quality of the groundwater is also discussed in this section since it could be impacted if land treatment is employed as a final method of wastewater disposal for either Aspen or Snowmass.

Institutional Goals and Constraints

This discussion explains the governmental legislation that affects the water quality and water flows of the project area. It is directed towards legislation that affects the operation of wastewater treatment plants and nonpoint source runoff. Topics include Public Law 92-500, National Pollution Discharge Elimination System, Areawide planning study (208), Basin planning study (303), State stream classifications and water rights.

Public Law 92-500: This law, called the Federal Water Pollution Control Act Amendments of 1972, sets up the legal framework for maintaining and improving our nation's waterways. It replaces the Federal Water Pollution Control Act and its amendments. It provides grant money for doing research on water quality and wastewater treatment, for planning control strategies and for actual construction of sewage treatment facilities. The Act (92-500) also sets up the National Pollutant Discharge Elimination System for issuing discharge permits. This system (NPDES) replaces the permit system established by the Refuse Act of 1899, under which permits for discharges into navigable waters were formerly issued.

Additional provisions of Public Law 92-500 require that all sewage treatment plants provide a minimum of secondary treatment to their wastewater effluents by July 1, 1977. This requirement has been defined by the EPA to mean a minimum of 85 percent of organic constituents (biological oxygen demand — BOD) and suspended solids must be removed from the wastewater. A Best Practicable Waste Treatment Technology (BPWTT) must also be applied before July 1, 1983. This technology has been defined by the EPA and could consist of alternative techniques, or direct reuse. The form it takes should be the most cost-effective alternative that provides the treatment necessary to attain the 1983 goal. This goal provides for the protection and propagation of fish, shellfish, and wildlife and also provides for recreation in and on the water; it is sometimes called the fishable/swimmable goal.

Public Law 92-500 is administered by the Administrator of EPA. From this control center authority is delegated to the states who are held responsible for carrying out certain sections of the law. The state of Colorado is participating in this action, through the authority of the Colorado Water Control Act of 1973. This Act designates the Colorado Department of Health as the administrator of the Act, to be carried out by its Water Quality Control Commission and its Water Quality Control Division. The Commission is assigned the tasks of classifying the state's waters on the basis of their water quality, establishing basic discharge standards and developing priorities for upgrading existing wastewater treatment. The Division administers and enforces the control programs adopted by the Commission.

National Pollutant Discharge Elimination System: This system provides Discharge Permits to Colorado entities discharging pollutants into state waters. It is administered by the Colorado Water Quality Control Division although it receives support and guidance from the Colorado Water Quality Control Commission and the EPA. The permits it issues must eventually conform to the 1977 and 1983 goals of Public Law 92-500, as well as adhere to water quality guidelines adopted by the Commission and the EPA. The current discharge permits for the project's existing plants are shown in Tables I-14, 16 and 18.

Areawide Planning Study (208): Section 208 of Public Law 92-500 authorizes areawide studies to develop wastewater treatment management plans. These plans are to include: the identification of treatment works necessary to control municipal wastes and industrial wastes for a 20-year period; the development of plans to control urban runoff from construction, livestock-holding areas and crop production sites; the identification of mine-related pollutants and the development of plans to control them; plus the development of plans to control landfills. All of these plans should include the identification of agencies to construct, operate and maintain any proposed facilities, and they should suggest a financial program for carrying it through to completion.

The 208 studies in Colorado are concentrating on six different areas, one of which includes Pitkin County and the study area. This study is directed by the Northwest Colorado Council of Governments and it includes six river basins in a six-county area. The scope of work has been defined and allocated to various governmental agencies. An important ingredient in this study is the identification of techniques for controlling urban and agricultural runoff, a major source of pollution in the Roaring Fork River basin.

Basin Planning Study (303): This study is required by Section 303(e) of PL 92-500 and is intended to establish goals and priorities with regard to water quality and wastewater effluent limitations. For the Aspen area, the applicable plan has been completed and is entitled the Roaring Fork River Basin Water Quality-Management Plan (Wright-McLaughlin Engineers, 1974). Based on computer model simulations, the treatment plants in the Aspen Metro area were allocated effluent loads for BOD, suspended solids, ammonia (NH_3-N) and residual chlorine. These allocations are summarized in Table I-1. Comparable allocations have also been determined for the Snowmass Water and Sanitation District and are listed in the same table.

TABLE I-1

EFFLUENT ALLOCATIONS

Parameter	Aspen Metro	Snowmass
BOD	464 lbs/day	225 lb/day
Suspended solids	464 lbs/day	225 lb/day
Ammonia (NH_3-N)	82 lbs/day	2 lb/day
Residual Chlorine	0.46 lbs/day	0.01 lb/day

These allocations have been taken by Wright-McLaughlin Engineers and combined with a proposed schedule for variable ammonia discharges to develop goals for 1977 and 1983. The proposed ammonia discharges are displayed in Table IV of Appendix A. They are designed to protect fish life although future permit standards could be less, to be equal to or less than existing performance records. The resultant goals for 1977 and 1983 are shown in Tables V and VI of Appendix A; compliance with these goals would enable the districts to adhere to state and federal discharge laws. A summary of the most stringent of these goals is given in Table I-2, the fishable/swimmable goals of 1983.

TABLE I-2

FISHABLE/SWIMMABLE GOALS OF 1983

	Aspen Metro	Snowmass
BOD	13 mg/ℓ	15 mg/ℓ
SS	13 mg/ℓ	20 mg/ℓ
NH_3	Equal to or less than existing discharges or proposed discharges of Table IV of Appendix A, whichever is less.	
Total N	- -	10 mg/ℓ
Total P	10 mg/ℓ	5 mg/ℓ
Residual Cl_2	.05 mg/ℓ	.05 mg/ℓ
Fecal Coliform	200/100 mℓ	200/100 mℓ

State Stream Classifications: The Colorado Water Quality Commission has established water quality conditions for classifying the state's waters. This role has resulted in establishing four categories: A_1, A_2, B_1 and B_2 (Table I of Appendix A). Streams with the A ratings are those that exhibit a high quality so they can be used for normal raw water purposes, including primary contact recreation (swimming, skiing, etc.); streams with B classifications are those that have a current and future use for non-contact recreation (primarily fishing, etc.). The numerical designation A_1 or B_1 refers to the designation for a cold water fishery, and A_2 or B_2 refers to a warm water fishery. Each stream in the state has been placed into one of these four categories; and each represents a minimum water quality that must be maintained at all times, except during drought periods when flow drops below the consecutive seven-day, ten-year low flow average. Each point-source discharge or group of discharges must receive the degree of treatment necessary, so as not to degrade the quality of the receiving stream. In the project area, the Roaring Fork River and all of its tributaries are currently classified as B_1 class streams — which is the cold water fishery designation. A summary of the water quality standards for all stream classifications is given in Table II of Appendix A.

Water Rights: Colorado allocates its water resources under the Appropriation Doctrine. This doctrine is based upon the concept "first in time, first in right." It is simple in its logic but generally complex in its administration. The professional water attorneys and hydrologists have created such an aura of complexity that public officials, laymen, and non-water right professionals have generally left this field of water to a handful of specialists. However, these specialists have worked well under the Appropriation Doctrine over the years. They have demonstrated that Colorado water law is flexible and that it can be adjusted to meet changing conditions.

A challenge to this flexibility could come from water users who are affected by a consumptive use of water by municipalities. This use would occur if land treatment of sewage is employed to provide advanced treatment of wastes. Since crops consume high quantities of water and vent it to the atmosphere, less water would be available for downstream users. However, since the project's potential irrigation lands are already irrigated, appropriated waters could be exchanged for effluent waters and downstream users could be protected. Such an exchange would require a long-term commitment from the land owners and this has yet to occur.

The proposed land treatment sites are shown on Study Map 4. The land along Brush Creek is irrigated by waters owned by the Snowmass American Corporation, Lemond and Upper Weise Ditch Company, and Pey and Jote Smith Ditch Company. The land in Owl Creek basin is irrigated by waters owned by the Willow and Owl Ditch Company and the McPherson Ditch Company; and along the Roaring Fork River they are owned by the Salvation Ditch Company. More details on ownership can be found in Wright-McLaughlin's 201 Facilities Plans for Snowmass and Aspen, Volume 2 (May 1976 and June 1976).

Existing Surface Water Quality and Quantity

The surface waters of the project area are used for domestic and agricultural purposes and must be protected to insure their continued value. They provide drinking water for the area's residents and they are direct receivers of secondary effluent from the three existing plants. The text that follows highlights existing information on these environments, dividing the discussion into sections on water quantity and water quality.

Water Quantity: The flow rates of the Roaring Fork River have been well documented by the United States Geological Survey (USGS). One of their gaging stations is located two miles upstream from the confluence with Hunter Creek and it has been operative since October 1964. The flow through this station originates from a drainage basin that encompasses 108 square miles. However, flows have lessened since May 24, 1935 due to a diversion of upstream waters to the Arkansas River Basin. This diversion occurs 14 miles upstream from the gaging station, where flow is channeled through the Twin Lakes Tunnel into Lake Creek.

The last year of reported data from the Aspen station is presented in Table I-3, organized according to monthly low flows, high flows and mean flows. The station's ten-year records indicate that the maximum instantaneous flow occurred on July 1, 1965, with a value of 1,310 cubic feet per second (cfs). Minimum daily flow occurred on February 20, 1973 with a value of 15 cfs. The average annual discharge of the Roaring Fork has been 147 cfs.

Immediately below this gaging station is a diversion point owned and operated by the Salvation Ditch Company. This company provides irrigation waters to ranchers northwest of Aspen, who irrigate about 2,200 acres. This practice is valuable to their livelihood, and it occasionally results in extremely low flows for the river at Mill Street. During the fall of 1974 the Aspen Times reported that the Roaring Fork River was essentially dry between the diversion point and Hunter Creek; a stretch which included the sewage outfall near Mill Street.

About 750 feet below this outfall, Hunter Creek joins the Roaring Fork. This stream increases the annual flow of the river by about one-third at its point of confluence. It also restores flow to the river when low flow and upstream diversions tend to minimize it. Its average annual discharge is about 53 cfs, recorded at a USGS gaging station located 1.5 miles from its mouth.

The next downstream tributaries of the Roaring Fork are Castle and Maroon Creeks, which join the river just west of Aspen. Their average annual discharges are not known, since their USGS gaging stations are several miles upstream from their mouths. An August 1973 study by the Colorado Health Department does provide some insight; it reported flows of 166 cfs for Castle Creek and 165 cfs for Maroon Creek. These flows occurred while upstream stations were recording flows below their average annual discharges. This comparison implies that both creeks should have average annual discharges over 100 cfs.

The discharges of the next downstream tributaries, Owl Creek and Brush Creek, are largely unknown. However, the flows of Brush Creek have received some recent attention since it receives effluent from the Snowmass Water and Sanitation District. Its flow was measured between August 21 and 27, 1973 by the Colorado Department of Health, and they recorded a flow of four cfs near the Roaring Fork. This flow could drop even further, according to the Roaring Fork River Water Quality Management Plan. A seven-day low flow rate of two cfs was projected, to occur with a frequency of once in ten years. A low flow of one

Table 1-3

Flow Rates of Roaring Fork River
Near Aspen, Colorado

October 1973 to September 1974

Month	Daily Low Flow (cfs)	Daily High Flow (cfs)	Mean Flow (cfs)
October	25	41	34.0
November	23	32	27.0
December	20	26	23.8
January	20	24	22.3
February	20	23	20.7
March	19	32	23.3
April	21	87	38.5
May	95	452	287
June	140	336	250
July	47	128	74.0
August	24	49	34.7
September	28	43	31.8

Maximum instantaneous flow: 612 cfs (May 29)

Minimum daily flow: 19 cfs (March 5) cfs for the upstream portion of Brush Creek was projected as it passes by the sewage outfall.

Water Quality: Less is known about the area's water quality than about its quantity. Information has been gathered on an irregular basis, sample parameters have varied considerably and some of the evaluations have questionable value. Most of the evaluations have been done by the Colorado Division of Game, Fish and Parks (Colo. GFP, now the Colorado Division of Wildlife), the Colorado Health Department (Colo. HD), the United States Forest Service (FS) and the United States Geological Survey (USGS). Additional evaluations were performed for the Water Quality Management Plan (Wright-McLaughlin, 1974).

Those evaluations done by the Colorado Division of Game, Fish and Parks are considered unreliable by the current administration, the Colorado Division of Wildlife (Goettl, 1976). They suggest that conclusions based on these data should not be considered until more reliable data can be compiled. Consequently, this information has been excluded from this analysis of the area's water quality.

Roaring Fork River: Water quality data for the Roaring Fork are summarized in Tables I-4 through I-6, and sample stations are shown in Figure D. Table I-4 presents data from three government sources, comparing it with Colorado standards for B_1 streams and the National Interim Primary Drinking Water Regulations (Federal Register, Dec. 24, 1975). The B_1 stream standards provide legal constraints for the water quality data of Table I-4 and are enforced by the Colorado Water Quality Control Division. The drinking water regulations do not yet legally apply; however, they are included to indicate a potential future use and to show how safe the streams are for campers and others who use them as drinking water. Table I-5 reports ammonia concentrations accumulated from two sewage outfalls near Aspen, and Table I-6 shows background levels of radioactivity in the Roaring Fork near Aspen.

The first table shows that the Roaring Fork meets the criteria for class B_1 streams and is adequate for public drinking water. The second table indicates that the Mill Street plant contributes much more ammonia to the river than the Aspen Metro plant. The discharge at Mill Street was 32 mg/ℓ. However, its concentration in the river was dissipated within 825 feet, where background levels of less than 0.10 mg/ℓ were restored.

The reason for concern over ammonia is that the un-ionized portion can be toxic to fish, depending on its concentration. This concentration can be calculated if pH and temperature are known, and it should not exceed 0.02 mg/ℓ (Willingham, 1976). This level has not been exceeded, according to calculations made from the data in Tables I-4 and I-5, and it is the maximum allowable for the maintenance of healthy fisheries. Since the Colorado Division of Wildlife classifies the Roaring Fork River as a fishery stream, this constraint has been considered by Wright-McLaughlin in their proposed designs of new wastewater treatment facilities. They have used data on stream flow, temperature and pH to establish acceptable levels of discharge. (Table V of Appendix A.)

TABLE I-4

ROARING FORK WATER QUALITY

Station	Sampler	Value	Date	Water Temp. °F	Water Temp. °C	Diss. Oxy. mg/ℓ	pH units	Turb. JTU	5-day BOD mg/ℓ	Susp. Solids mg/ℓ	NH_3-N mg/ℓ	NO_3-N mg/ℓ	PO_4-P mg/ℓ	SO_4 mg/ℓ	Cl mg/ℓ	TDS mg/ℓ	Spec. Cond. umhos	Coliforms per 100 ml Total	Coliforms per 100 ml Fecal	Total Alkalinity as $CaCO_3$ mg/ℓ	Phenol-phthalein Alkalinity as $CaCO_3$ mg/ℓ	Total Hardness mg/ℓ	Ca mg/ℓ	Mg mg/ℓ	SiO_2 mg/ℓ
2	FS	Min.	7/12/74-	51			7.7	0.5				0.3	0.04		0.5		50			20.[illegible]		14	8	6	6.3
		Max.	7/1/75	59			8.0	1.6				0.3	0.04	7.0	3.5		[illegible]			35.[illegible]	0	50	42	8	6.3
[illegible]	Colo.	Min.	8/14/73		9.0	8.0	7.1	0.5	[illegible]		0.05				14	48	70								
	MD	Max.	8/27/73		14.5	10.0	8.0	1.0	1.2	3	0.10	0	0		18	58	76	<200	<200						
4	Colo.	Min.	8/14/73-		10.0	6.9	7.8	0.7	1.1	1	0.05	0	0		10	91	123	<200							
	MD	Max.	8/27/73		15.5	8.2	8.0	0.8	2.3	4	0.15	0.8	0.07		14	102	142	450	<200						
5	Colo.	Min.	8/14/73-		11.5	7.4	7.7	0.8	0.8	1	0.05		0		10	90	118	<200							
	MD	Max.	8/27/73		15.5	9.2	8.2	1.0	1.7	6	0.05	0	0.07		16	108	153	550	<200						
10	Colo.	Min.	8/14/73-		9.2	8.0	8.0	0.7	0.9	1	0	0.5			10	197	273								
	MD	Max.	8/27/73		11.8	9.6	8.9	1.0	1.6	2	0.05	1.0	0		14	238	300	<200	<200						
16	Colo.	Min.	8/14/73	7.0	7.0	8.3	7.6	0.6	0.5	1	0	0.5			10	223	315								
	MD	Max.	8/27/73		13.3	12.2	8.9	1.0	1.9	5	0.05	0.8	0		18	242	316	<200	<200						
18	Colo.	Min.	8/14/73-		7.0	7.7	8.4	0.7	0.9		0	0.5	0		12	244	327								
	MD	Max.	8/27/73		13.3	9.6	9.0	1.0	1.4	0	0.05	1.0	0.09		16	252	380	<200	<200						
Colorado Standards (B_1 Streams)				68	20.0	>6	6.0-9.0	No Change >10											1000						
National Interim Primary Drinking Water Regulations								1.0				10.0													

TABLE I-5

CONCENTRATIONS OF NH_3-N IN ROARING FORK RIVER

October 15-17, 1974

Distance from ASD Outfall[a] Ft.	-75	+45	+145	+250	+385	+400	+500	+625	+825	+1025	+1225	+1425	+1625
NH_3-N mg/l	0	0.10	0.35	0.30	0.20	0.15	0.15	0.15	0.10	0.10	0.10	0.10	T[b]

Distance from AMSD Outfall[c] Ft.	-50	+100	+200
NH_3 mg/l	0	0.10	T[b]

[a] Discharge contains 32.0 mg/l NH_3-N

[b] T = trace

[c] Discharge contains 3.0 mg/l NH_3-N

The concentrations of radioactive particles in the Roaring Fork River are well within acceptable limits for human health (Table I-6). It should not be a problem in the future, either, unless uranium mining is undertaken in upstream drainages (Lammering, 1975).

Other guidelines for stream quality come from the EPA's technical reports, Water Quality Criteria 1972 and Quality Criteria for Water, which provide recommendations for the maintenance of a healthy aquatic environment. These guidelines are not exceeded in the Roaring Fork River and attest to its generally high quality for aquatic organisms.

Tributaries to the Roaring Fork: The water quality of the study area's three major tributaries is shown in Table I-7, as reported by the Colorado Department of Health. These tables show that the primary drinking water tolerances are not exceeded in any of the streams and that their stream quality is within standards for B_1 streams.

The general water quality of Brush Creek is depicted in Tables I-8 and I-9. All of these parameters are within standards for drinking water and B_1 streams, except for turbidity and pH. Turbidity is an indirect means of measuring suspended solids, and is known to have been high for many years in Brush Creek (Garbas, 1975). Turbidity was high even before the construction of Snowmass resort. However, a development such as the Resort does increase the volume of surface runoff by reducing the amount of permeable surfaces. This increase, in turn, increases the erosion of particles into the drainage basin. Consequently, Snowmass has probably made the suspended-solids condition in Brush Creek worse, even though its exact contribution is not known.

Despite the relative contributions from man-induced or natural sources, the total amount of suspended solids is known for several collection periods in 1974 (Wright-McLaughlin, Nov. 1975). These amounts are shown in Table I-10, where values vary between 8 and 1440 mg/ℓ.

Aspen's municipal water supply comes from Castle and Maroon Creeks and Snowmass's comes from Snowmass Creek. These waters are analyzed periodically by the Colorado Department of Health when they analyze tapwater. A summary fo their most recent analysis is shown in Table I-11, indicating high quality drinking water for both of these systems.

Groundwater: The groundwater resources of the project are poorly known in terms of water quality and fairly well known in terms of well yield. The former is especially important in terms of land treatment alternatives, since irrigation waters can reach the groundwaters and alter their quality. If this alternative of wastewater treatment is chosen, monitor holes should be established and periodic sampling undertaken.

The available information on quality comes from two wells that are described in Table I-12. Their quality is displayed in Table I-13 and compared with the national interim primary drinking water standards. This table shows that

Table 1-6

Roaring Fork Water Quality

Radioactive Background

Station	2		2	
Sampler	USGS		USGS	
Date	10/7/72 to 12/17/73		4/6/70 to 1/6/75	
Value	Min.	Max.	Min.	Max.
Alpha-D as U-Nat. pc/1	1.4	1.4		
Alpha-S as U-Nat. pc/1	0.2	0.2		
Beta-D as Cs_{137} pc/1	1.7	2.5	2.9	6.4
Beta-S as Cs_{137} pc/1	0.5	1.0	0.6	3.8
H_3 Total pc/1	480	670	320	1184
Beta-D as Sr_{90} pc/1	1.4	2.0	2.3	5.2
Beta-S as Sr_{90} pc/1	0.5	1.0	0.6	3.3

lorado drinking water standards specify gross alpha or beta
ivity should be less than 1000 pc/1.

TABLE 1-7

WATER QUALITY OF HUNTER, CASTLE AND MAROON CREEKS

Station	7		9		12			
Sampler	Colorado Health Department							
Date	August 14-17 1973						Colorado B1 Stream Standards	National Interim Primary Drinking Water Regulations
Value	Min.	Max.	Min.	Max.	Min.	Max.		
Water Temp. °C	11.0	15.0	8.0	12.8	8.7	12.0	20	
Dissolved Oxygen mg/1	8.1	8.8	7.5	9.9	8.3	10.5	>6	
Turbidity JTU	1.0	5.0	0.4	1.0	0.4	1.0	No Change >10	1.0
BOD 5-day mg/1	0.5	1.6	0.3	1.2	0.7	1.1		
Suspended Solids mg/1	4	9	2	5	2	2		
NH_3-N mg/1	0.05	0.15	0	0.05	0	0.05		
NO_3-N mg/1		0		0		0		10
PO_4 mg/1	0	0.3		0	0	0.3		
Chlorides mg/1	12	15	14	18	14	18		
TDS mg/1	55	66	234	284	251	284		
Spec. Cond. Umhos/cm	82	85	322	377	327	343		
Total Coliforms per 100 ml		<200		<200		<200		
Fecal Coliforms per 100 ml		<200		<200		<200	<1000	

TABLE 1-8

WATER QUALITY OF BRUSH CREEK

Station	13		14		15			
Sampler	FS		FS		FS			
Date	7/2/73 to 7/1/75						Colorado B1 Stream Standards	National Interim Primary Drinking Water Regulations
Value	Min.	Max.	Min.	Max.	Min.	Max.		
Water Temp. °F	47	56	47	59	54	60	68	
Turbidity JTU	2.2	99	3.7	15	22	98	No Change >10	1.0
Cond. umhos/cm	62	165	118	300	140	480		
Dissolved Oxygen mg/1	8.5	8.5	7.8	7.8	7.5	7.5	6	
pH	7.8	9.0	8.4	9.1	8.4	9.1	6.0-9.0	
Total Alkalinity as $CaCO_3$ mg/1	28	80	60	126	70	182		
NO_3-N mg/1	0.3	0.4	0.2	0.65	0.65	0.8		10
PO_4 mg/1	0.05	0.15	0.15	0.20	0.7	0.8		
Total hardness as $CaCO_3$ mg/1	24	110	60	182	70	230		
Calcium mg/1	20	94	52	134	62	158		
Magnesium mg/1	4	16	14	48	18	88		
Chloride mg/1	0.5	3.5	0.5	3.5	2.5	10		
Sulfate mg/1	2	12	4	45	8	64		
Silica mg/1	3.7	3.7	4.8	4.8	4.9	4.9		
Fecal Coliforms per 100 ml		<200		<200		<200	<1000	

TABLE 1-9

WATER QUALITY OF BRUSH CREEK

Station	17		17			
Sampler	Colo. HD		Colo. HD			
Date	Aug. 14-27 1973		Oct. 15-17 1974		Colorado B1 Stream Standards	National Interim Primary Drinking Water Regulations
Value	Min.	Max.	Min.	Max.		
Water Temp. °C	10	17	6	8	20	
Dissolved Oxygen mg/l	6.8	8.4	10.1	10.4	>6	
Turbidity JTU	11	15			No Change >10	1.0
BOD 5-day mg/l	1.4	2.6				
Suspended Solids mg/l	29	32				
NH_3-N mg/l	0.10	0.20	T	<0.2		10.0
Un-ionized NH_3-N mg/l			0	<0.02		
NO_3-N mg/l	3.0	4.0				
PO_4 mg/l	1.10	1.20				
Chlorides mg/l	14	20				
TDS mg/l	271	291				
Cond. umhos/cm	387	410				
Total Coliforms per 100 ml	<200	440				
Fecal Coliforms per 100 ml		<200			<1000	

TABLE I -10

WATER QUALITY DATA - BRUSH CREEK
FROM SNOWMASS DRAINAGE STUDY
(WRIGHT-McLAUGHLIN SAMPLING PROGRAM - 1974)

Sampling Station	Q cfs	BOD mg/l	Sus. Sol. mg/l	COD mg/l	[illegible] mg/l	[illegible] mg/l	TDS mg/l	Sampling Period
F. Brush Creek above Vidal Gulch[1]	0.6/0.8[2]		16/10	1.9/3.8				March
	0.6 -		18 -	48 -				April
	30		14	4.0				May
G. Brush Creek below confluence of Vidal Gulch	1.3/1.7		16/25	1.5/1.1				March
	- -		- 8	- -				April
	45		300	19				May
B. Brush Creek @ [illegible]	-		-	-				March
	1.9 -		65 61	26 -				April
	-		-	-				May
C. Brush Creek below Village, below Wood Road	1.3/1.5	2.9	110/200	18/23	3.6	< 0.1	181	March
	3 -		80/50 31	16/23 -				April
	98		100	19				May
E. Brush Creek above confluence w/Middle Fork @ Benedict's	-		-	-				March
	3.5 -		105 -	11 -				April
	60		170	41				May
D. Brush Creek below Faraway Ranch, above Brush Creek Road	4.7/5.8	25	150/305	14/21	3.9	< 0.1	218	March
	4 -		91 47	8 -				April
	66		1020	86				May
A. Brush Creek above STP	7.5/117		120/110	2.9/3.9				March
	- -		83 35	22 -				April
	-	9.0	990	30	1.6	< 0.1	1230	May
Q. Brush Creek below STP	-		-	-				March
	- -		102 16	25 -				April
	-		-	-				May
P. Brush Creek @ 48" CMP, Hy. 82	-		-	-				March
	- -		55 -	21 -				April
	85		1000	87				May

(1) Each letter refers to specific sampling locations as identified in the Drainage Study.

(2) Two numbers shown on the same line separated by a slash indicates morning/evening sampling.

TABLE I-11

TAP WATER ANALYSIS

Station	Pitkin County Courthouse	Snowmass Water and Sanitation Building	National Interim Primary Drinking Water Regulations
Sampler	Colo. HD	Colo. HD	
Date	5/21/74	3/12/74	
Total Solids mg/l	213	97	
Turbidity JTU	0.29	0.21	1.0
Conductivity umhos/cm	228	170	
Calcium mg/l	128	76	
Magnesium mg/l	7	3	
Sodium mg/l	2	1	
Total Hardness as $CaCO_3$ mg/l	158	90	
Total Alkalinity as $CaCO_3$ mg/l	72	90	
SO_4 mg/l	96	5	
Chloride mg/l	4	7	
Silica mg/l	6	6.8	
Fluoride mg/l	0.8	0	1.4 to 2.4
Selenium mg/l	0.004	0	0.01
Zinc mg/l	0	0.24	
Boron mg/l	0	0.07	
Alpha Emissions pc/l	0	0-16.5	

The following parameters were sampled and received values of zero or were below levels of detection: Fe, Mn, As, Cd, Cr, Cu, Pb, Se, Mo, NO_3, PO_4, NH_3 and Beta emissions.

TABLE I-12

WELL DESCRIPTION

Owner	Aspen	Aspen
Well Number	1	2
Location	NW-S18 T10S, R84W	S7 T10S, R84W
Year Drilled	1960	
Type of Well	Drilled	
Depth	165'	18'
Diameter	8"	
Aquifer Material	Sand, Gravel	
Geological Source of Aquifer Material	Alluvium	Alluvium
Type of Life	Turbine	
Type of Power	Electrical	
Horsepower	40	
Yield	250 gpm	
Depth to Water	25'	

TABLE I-13

GROUNDWATER QUALITY

Identity	Aspen #1	Aspen #1	Aspen #2	Aspen #2	
Location	NW$\frac{1}{4}$18 T10S R84W	NW$\frac{1}{4}$18 T10S R84W	S7 T10S R84W	S7 T10S R84W	National Interim Primary Drinking Water Standards
Date	9/20/60	2/16/61	5/30/59	5/30/59	
Temperature °F		49	42	47	
Silica mg/1	14	4.7	11	14	
Iron mg/1	0	0			
Manganese mg/1	0	0			
Calcium mg/1	28	26	22	18	
Magnesium mg/1	6.6	8.8	4.4	3.4	
Sodium mg/1	4.9	5.0	4.7	7.8	
Potassium mg/1	0	0.4			
Bicarbonate mg/1	114	116	36	76	
Carbonate mg/1	0	0	0	0	
Sulfate mg/1	8.4	9.0	23	8	
Chloride mg/1	0.4	1.0	3.5	0.5	
Fluoride mg/1	1.8	1.2	0.3	1.2	
NO_3 mg/1	0.9	0	31	0.7	45[a]
TDS mg/1	133	121	118	91	
Hardness mg/1	97	102	74	58	
Non-Carb. Hardness	4	7	4	0	
SAR	0.2		0.2	0.4	
Cond. umhos/cm	211	210	181	133	
pH	7.2	8.1	7.1	7.7	

[a] 10 mg per ℓ as NO_3-N

the water was of acceptable quality between 1959 and 1961. However, this information may not reflect the current status due to the urban impact since 1961.

WASTEWATER DISCHARGES AND EXISTING TREATMENT FACILITIES

The purpose of this section is to describe in greater detail the present sewage treatment services, their capacities and flows, infiltration problems and compliance with current standards. These discussions focus on three most significant discharges in the study area: the Aspen Sanitation District Sewage Treatment Plant (ASD), the Aspen Metro Sanitation District Sewage Treatment Plant (AMSD) and the Snowmass Sewage Treatment Plant. Topics of discussion include the three separate plants, the Aspen Metro sludge disposal facilities and a summary of their compliance records and performance expectations.

Aspen Sanitation District Plant

The ASD plant was completed in 1958, then upgraded in 1968 to provide additional treatment for higher loadings and to overcome operating problems. The plant basically serves the City of Aspen and is located at the foot of Mill Street. Its treatment scheme is primary clarification, followed by a trickling filter, an aeration basin and secondary clarification (Figure E). After secondary clarification the wastewater is disinfected by chlorination, then discharged to the Roaring Fork River. The sludge from primary clarifier is anaerobically digested and, along with waste sludge from the secondary clarifier, is trucked to the Metro disposal site. The capacity of the ASD plant is 0.5 million gallons per day (mgd) with an average flow of 0.45 mgd. When its collection system generates flows greater than the plant's capacity, they are bypassed to the Aspen Metro Sewage Plant.

The treatment levels achieved at the ASD plant have been quite high since utilizing this bypass arrangement to the Metro Plant. A summary of its influent and effluent water quality is given in Table I-14 as reported by the ASD plant to the Colorado Department of Health. A summary of its state discharge permit is given in Table I-15. A comparison between the two shows that the plant is currently in compliance with its permit. However, without modifications or additions, it will not be in compliance with the 1977 provisions of the permit especially with respect to ammonia and residual chlorine (see Table I-5 for ammonia discharges).

Aspen Metro Sanitation District Plant

The AMSD treatment plant was first placed into service in January 1970 as an extended aeration facility with a 0.7 mgd capacity. The plant was then expanded to the current 2.0 mgd capacity in 1973, and the process was converted to a conventional activated sludge process. This process begins with pretreatment, followed by two aeration basins and then an overflow into two secondary clarifiers. The overflow from the clarifiers is then directed to a polishing pond, which is divided into two sections. The first section comprises about one-third of the total area and is aerated, the other section is not. After being retained in the pond, the treated effluent is chlorinated and discharged into the Roaring Fork River. The sludge from the secondary

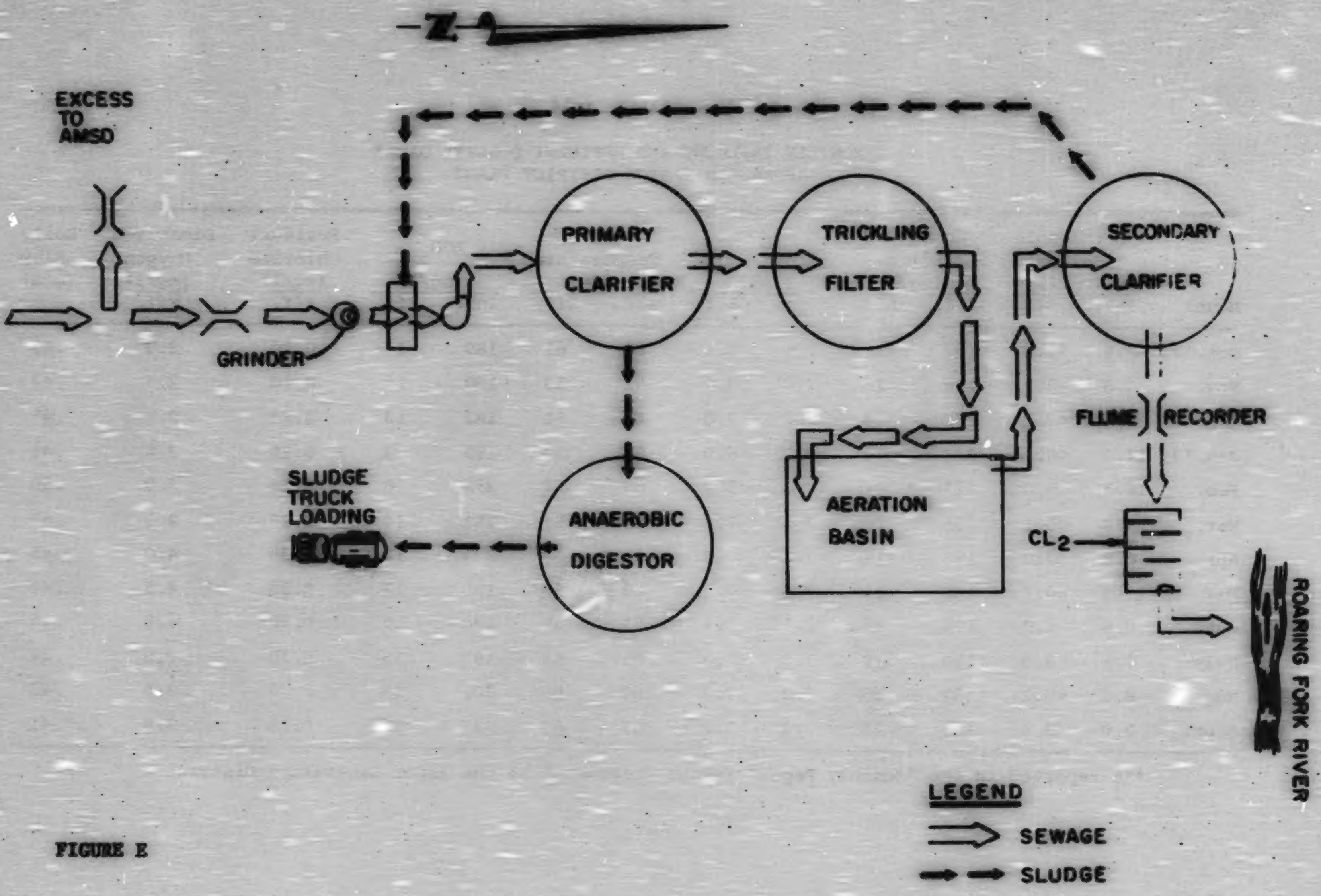

N
EXCESS TO AMSD
GRINDER
PRIMARY CLARIFIER
TRICKLING FILTER
SECONDARY CLARIFIER
ANAEROBIC DIGESTOR
SLUDGE TRUCK LOADING
AERATION BASIN
FLUME
RECORDER
CL2
ROARING FORK RIVER
LEGEND
SEWAGE
SLUDGE

FIGURE E

ASD-TREATMENT PLANT SCHEMATIC FLOW DIAGRAM

TABLE I-14

MONTHLY INFLUENT AND EFFLUENT QUALITY DATA*
ASPEN SANITATION DISTRICT PLANT

Month	Settleable Solids (mg/l) Inf.	Settleable Solids (mg/l) Eff.	Suspended Solids (mg/l) Inf.	Suspended Solids (mg/l) Eff.	pH Inf.	pH Eff.	Temperature (°F) Inf.	Temperature (°F) Eff.	BOD_5 (mg/l) Inf.	BOD_5 (mg/l) Eff.	Residual Chlorine (mg/l) Eff.	Dissolved Oxygen (mg/l) Eff.	Daily Flow (mgd)
Oct.'74	7.8	<0.1	157	16	7.0	7.0	65	61	189	15	0.20	2.9	.43
Nov.	7.8	<0.1	174	13	7.0	7.0	62	53	189	15	0.20	2.7	.42
Dec.	8.0	<0.1	172	14	7.0	7.0	61	51	182	13	0.20	2.9	.45
Jan.'75	14.0	<0.1	203	14	7.0	6.9	61	52	195	9	0.20	2.6	.49
Feb.	14.5	0.0	217	12	7.0	7.0	60	52	258	8	0.25	2.9	.50
Mar.	14.4	<0.1	201	19	7.0	7.0	61	57	251	14	0.25	2.9	.53
Apr.	8.6	0.0	195	11	7.0	7.0	58	52	233	12	0.30	4.0	.45
May	5.8	<0.1	180	11	7.1	7.4	59	58	198	12	0.30	4.5	.42
June	6.8	0.0	178	15	7.1	7.1	61	59	198	16	0.20	3.6	.45
July	7.1	0.0	190	12	7.3	7.3	65	65	197	15	0.20	3.8	.46
Aug.	8.0	<0.1	187	16	7.3	7.2	67	66	201	15	0.20	3.5	.43
Sept.	8.0	<0.1	188	13	7.3	7.2	67	63	227	12	0.20	3.6	.41

*As reported in the "Monthly Report Sewage Treatment" by the Aspen Sanitation District.

TABLE I-15

ASPEN SANITATION DISTRICT SEWAGE TREATMENT PLANT EFFLUENT LIMITATIONS[+]

Parameter	Present				After July 1, 1977*			
	30 Day	7 Day	Daily	Instantaneous	30 Day	7 Day	Daily	Instantaneous
BOD_5 (mg/l)	30	45			22	30		
Total Suspended Solids (mg/l)	30	45			22	30		
pH				6.0-9.0				6.0-9.0
Fecal Coliforms (organisms/100 ml)				5000	200	400		
Total Residual Chlorine (mg/l)				0.5 (max.)		0.02		0.31
Oil and Grease (mg/l)				10				10
Ammonia (asN) (mg/l)						2.7	4.1	

[+] As specified in Permit No. CO-0020982

*Concentrations of certain pollutants are based on allowable total load and a flow of 0.5 mgd. Allowable effluent loadings for a 30 consecutive day period are: BOD_5, 94 lb/day; total suspended solids, 94 lb/day; ammonia (as N), 11.4 lbs/day; and total residual chlorine, 0.065 lb/day.

clarifiers is pumped to a third aeration basin that acts as an aerobic digester; once digested, this sludge is then trucked to the sludge disposal site. During periods of low flow, one of the two secondary clarifiers is also used for thickening the sludge material. A process flow schematic of the AMSD plant is given in Figure F.

The plant is now capable of treating an average daily flow of 2.0 mgd and has consistently produced a high quality effluent at those flow levels. A summary of plant effluent data is given in Table I-16, as reported to the Colorado Department of Health. A summary of its current discharge permit is given in Table I-17. As was the case with the ASD plant, the AMSD plant is currently in compliance with their permit. However, if additional treatment measures are not taken, the plant would no longer be expected to be in compliance as of July 1, 1977 due to more stringent ammonia and residual chlorine limitations.

Snowmass Plant

The current situation for the Snowmass Water and Sanitation District is significantly different from the Aspen Metro District — principally because Brush Creek carries much less flow than does the Roaring Fork. The only significant point source discharge to Brush Creek is the Snowmass sewage treatment plant, which sometimes makes up the majority of Brush Creek's flow.

The Snowmass sewage treatment plant was first placed into service in 1967 and then expanded to its present capacity of 0.8 mgd. Its location is near Brush Creek just east of the Snowmass Golf Course. The plant is a secondary biological type, utilizing the contact stabilization process without primary clarification. It serves all major developments within the Snowmass District except Sam's Knob Restaurant, which uses a septic tank-tile field system.

Pretreatment is provided first, followed by two aeration basins and secondary clarification. After secondary clarification the effluent flows to an aerated polishing pond, where flow leveling occurs before the effluent is chlorinated and discharged to Brush Creek. Return activated sludge from the secondary clarifiers is directed to a reaeration basin and then back to the mixed-liquor aeration basin. Waste sludge from this basin is sent to an aerobic digester and then returned to the same basin. The resultant cycle produces very small quantities of sludge, which are trucked to the Metro sludge disposal site near the Roaring Fork River. If more sludge is produced in the future, it can be thickened prior to disposal. A process flow schematic of the AMSD plant is given in Figure G.

As stated earlier, the plant is now capable of treating an average flow of 0.8 mgd and has consistently produced high quality secondary effluent at those flow levels. A summary of plant effluent data is given in Table I-18, as reported to the Colorado Department of Health; a summary of its permit is given in Table I-19. A comparison of the two shows that in most respects the Snowmass plant is currently in compliance with their State permit. However, suspended solids have exceeded permit limitations on several occasions, probably for two reasons. First, since the current operation

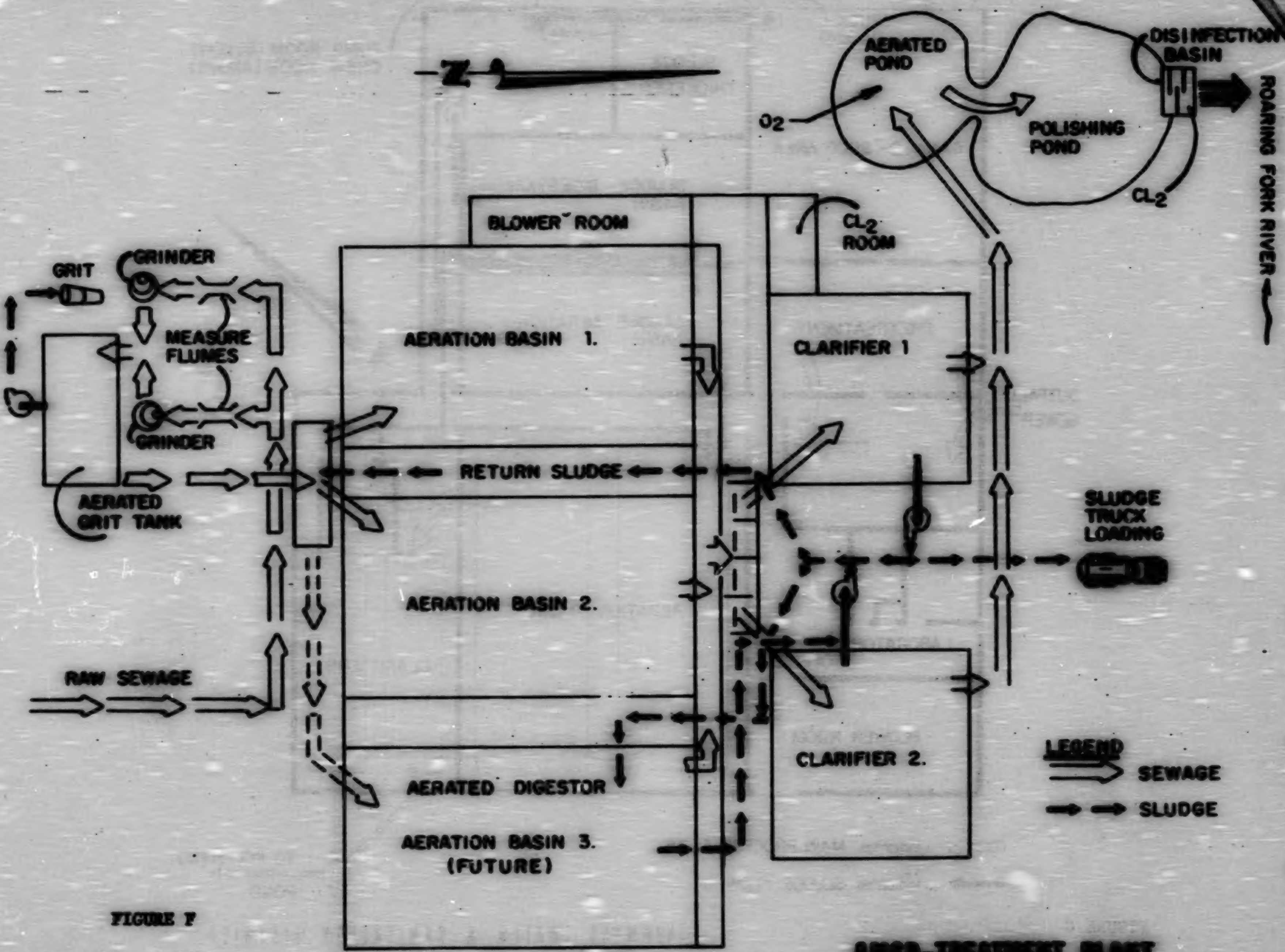

N
AERATED POND
O2
POLISHING POND
DISINFECTION BASIN
CL2
ROARING FORK RIVER
BLOWER ROOM
CL2 ROOM
GRIT
GRINDER
MEASURE FLUMES
GRINDER
AERATED GRIT TANK
AERATION BASIN 1.
RETURN SLUDGE
CLARIFIER 1
SLUDGE TRUCK LOADING
AERATION BASIN 2.
RAW SEWAGE
AERATED DIGESTOR
AERATION BASIN 3.
(FUTURE)
CLARIFIER 2.
LEGEND
SEWAGE
SLUDGE

FIGURE F

AMSD-TREATMENT PLANT SCHEMATIC FLOW DIAGRAM

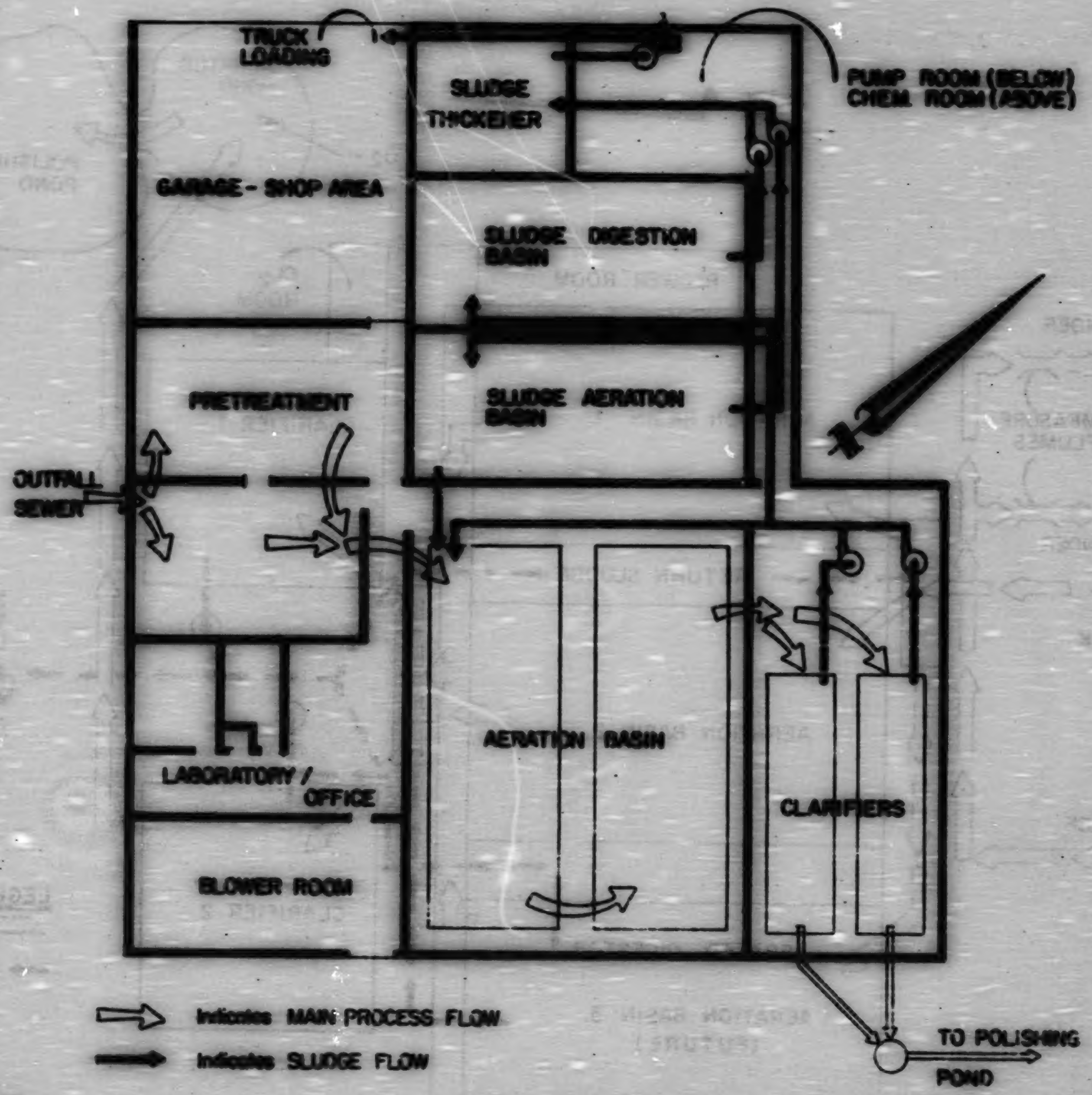

TRUCK LOADING
PUMP ROOM (BELOW)
CHEM. ROOM (ABOVE)
SLUDGE THICKENER
GARAGE - SHOP AREA
SLUDGE DIGESTION BASIN
SLUDGE AERATION BASIN
PRETREATMENT
OUTFALL SEWER
AERATION BASIN
CLARIFIERS
LABORATORY / OFFICE
BLOWER ROOM
TO POLISHING POND
Indicates MAIN PROCESS FLOW
Indicates SLUDGE FLOW

FIGURE G

SNOWMASS WATER & SANITATION DISTRICT

EXISTING FACILITIES

TABLE I-16

MONTHLY INFLUENT AND EFFLUENT QUALITY DATA
ASPEN METRO SANITATION DISTRICT PLANT

Month	BOD$_5$ (mg/ℓ) Inf.	BOD$_5$ (mg/ℓ) Eff.	Suspended Solids (mg/ℓ) Inf.	Suspended Solids (mg/ℓ) Eff.	pH Inf.	pH Eff.	NH$_3$-N (mg/ℓ) Inf.	NH$_3$-N (mg/ℓ) Eff.	NO$_3$-N (mg/ℓ) Inf.	NO$_3$-N (mg/ℓ) Eff.	PO$_4$-P (mg/ℓ) Eff.	Cl$_2$ (mg/ℓ) Eff.	Dissolved Oxygen (mg/ℓ) Eff.	Settleable Solids (mg/ℓ) Inf.	Settleable Solids (mg/ℓ) Eff.	Temperature (°F) Inf.	Temperature (°F) Eff.	Daily Flow (mgd)
Oct. '74	245	10	210	16	7.3	7.2	--	3.6	--	--	--	0.5	7.0	6.9	0.0	57	50	.69
Nov.	232	8	193	4	7.4	7.2	--	2.3	--	--	--	0.4	8.3	7.2	<0.1	53	41	.67
Dec.	225	6	190	7	7.4	7.3	--	8.0	--	--	--	0.3	8.5	8.6	<0.1	51	37	.98
Jan. '75	237	9	204	11	7.6	7.4	28	24	--	--	--	0.3	8.3	8.4	<0.1	51	38	1.15
Feb.	269	9	233	10	7.4	7.3	25	25	--	--	11.9	0.3	6.3	9.3	<0.1	51	44	1.08
Mar.	235	9	274	10	7.5	7.3	28	25	--	0.5	11.9	0.3	6.3	10.6	<0.1	51	45	1.13
Apr.	248	16	231	16	7.5	7.2	12	14	--	1.6	1.9	0.3	6.2	9.0	<0.1	48	46	.56
May	221	15	237	18	7.4	7.2	13	[illegible]	--	12	4.9	0.2	8.5	8.5	0.1	50	50	.67
June	193	8	180	17	7.3	7.2	16	8.4	--	3.9	4.0	0.3	5.6	5.5	0.1	54	56	1.20
July	231	12	190	17	7.3	7.3	25	17	7.6	2.1	5.6	0.2	5.3	7.3	<0.1	62	62	1.85
Aug.	240	14	239	19	7.1	7.1	33	24	4.1	1.9	5.6	0.2	7.2	9.1	0.1	63	62	1.51
Sept.	298	17	266	18	7.2	7.1	25	9.9	5.6	4.4	4.5	0.3	9.5	6.6	<0.1	61	65	1.10

*As reported in the "Monthly Report Sewage Treatment" by the Aspen Metro Sanitation District.

TABLE I-17

ASPEN METRO SANITATION DISTRICT SEWAGE TREATMENT PLANT EFFLUENT LIMITATIONS⁺

Parameter	Present				After July 1, 1977*			
	30 Day	7 Day	Daily	Instantaneous	30 Day	7 Day	Daily	Instantaneous
BOD_5 (mg/l)	30	45			22	30		
Total Suspended Solids (mg/l)	30	45			22	30		
pH				6.0-9.0				6.0-9.0
Fecal Coliforms (Organisms/100 ml)				5000	200	400		
Total Residual Chlorine (mg/l)				0.5 (max.)		.03		0.5
Oil and Grease (mg/l)				10				10
Ammonia (as N) (mg/l)						4.9	7.4	

⁺As specified in Permit No. CO-0026387

*Concentrations of certain pollutants are based on allowable total load and a flow of 2.0 mgd. Allowable effluent loadings for a 30 consecutive day period are: BOD_5, 370 lb/day; total suspended solids, 370 lb/day; ammonia (as N), 81.6 lb/day; and total residual chlorine, 0.46 lb/day.

TABLE I-18

SNOWMASS WASTEWATER TREATMENT PLANT
EFFLUENT QUALITY*

Date Sampled	Type of Sample	BOD mg/l	COD mg/l	DO mg/l	Set. Sol. mg/l	Vol. Sol. mg/l	SS mg/l	TDS mg/l	Kjel. N mg/l	NH_3-N mg/l	NO_3 mg/l	Total P mg/l	PO_4-P mg/l	Resid. Chlor. mg/l	pH	Turbidity JU	Color Units	Oil & Grease mg/l	Fecal coli/ 100 ml	Total coli/ 100 ml	Chlorides mg/l	Cond. mg/l
10/18/72	—	7.3	—	—	0.1	28.0	38.0	—	—	—	—	—	—	—	—	—	—	—	—	<220	—	—
1/18/73	6 hr. Comp.	7.5	38.0	9.2	--	—	16.0	—	6.5	8.6	2.5	—	24.0	1.5	—	22.0	20.0	1.9	<5	—	—	—
6/5/73	6 hr. Comp.	11.5	30	15	0.1	—	22	—	—	—	—	—	—	0.1	—	3	15	1.7	<22	—	—	—
8/22/73	Grab	13.5	—	11.1	0.1	—	36	194.0	—	3.0	2.8	—	14.0	—	7.8	11	—	—	<2000	—	46.0	305.0
8/23/73 thru 8/28/73(1)	24 hr. Comp.	13.0	—	10.3	0.1	—	35	196	—	3.3	2.6	—	13.4	—	—	10	—	—	<2000	—	31	292
3/10/74 thru 3/14/74(2)	24 hr. Comp.	12.6	40	13.5	0.1	—	13.3	—	—	—	—	—	—	0.15	7.5	6.0	21.6	—	3.5	—	—	—
7/8/74	6 hr. Comp.	10.0	—	9.2	0.1	—	28.0	—	—	--	—	—	—	0.5	7.3	7.5	20.0	1.4	<22	—	—	—
12/11/74	6 hr. Comp.	6	—	9.6	—	—	11	—	12.5	4.4	—	5.2	—	0.4	7.7	8.9	5	—	2.2	—	—	—
5/28/75	Comp.	16.0	—	—	<0.1	—	8.0	—	—	2.0	—	1.26	—	—	8.7	4.3	18.0	—	<22	—	—	—

*Data from Colorado Department of Health, Water Pollution Controll Division (1972-1975)

(1) Represents the average of 5 samples.

(2) Represents the average of 3 samples.

TABLE I-19

SNOWMASS WATER AND SANITATION DISTRICT
DISCHARGE PERMIT

Parameter	Discharge Limitation Concentration 30-day Avg.	 7-day Avg.
Effective immediately and lasting through August 31, 1976.		
BOD_5 (mg/l)	30	45
SS (mg/l)	30	45
Fecal Coli. (#/100 ml)	1000	--
Total Residual		
Chlorine mg/l)	0.1	--
Oil and grease (mg/l)	10, also no visible sheen	
pH	6.0-9.0	--
Effective as soon as reasonable, but no later than September 1, 1976		
BOD_5 (mg/l)	30	45
SS (mg/l)	30	45
Fecal Coli. (#/100 ml)	200	400
Total Residual		
Chlorine (mg/l)	0.05	--
Oil and Grease (mg/l)	10, also no visible sheen	
pH	6.0-9.0	--
Ammonia Nitrogen (asN)	0.6 mg/ℓ , or 2.0 lb/day	

diverts all sludge back to the aeration basins, and since very little sludge is removed from the plant site, some of the inert portion of this material is probably being carried into the effluent stream. A second cause would be algal growth in the polishing pond at certain times of the year.

If no additional treatment facilities are provided, it is evident that the Snowmass Plant will no longer be in compliance with the permit limitations as of July 1, 1977; this is particularly true in respect to the ammonia and residual chlorine limitations.

Aspen Metro Sludge Disposal Facilities

The sludge from both the Aspen and Aspen Metro plants are currently disposed of at a site near Woody Creek. This site is comprised of about 50 acres of relatively flat but rocky ground on the W/J Ranch, approximately two miles northwest of the Aspen Metro plant. The site is inclined southward at a slope of one percent, and a runoff collection basin is located on its north end.

Approximately 175 dry tons per year of sludge are produced at the two Aspen plants. The anaerobically digested sludge from the AMSD plant is one to two percent. Sludges from both plants are currently trucked to the site.

The original plan for the disposal operations, which were approved by Pitkin County, was to dig trenches and fill them with the sludge produced during the winter months. During the summer the sludges were to be removed and worked into the soil, and trees or an alternate crop were to be planted on these soils and the nutrient value of the sludges would be utilized by them. Sludge produced during the summer would not be placed into trenches but would be mixed directly with the soil.

The first winter of operation, between 1974 and 1975, was not operated according to the plan. The trenches were not constructed prior to the onset of winter and the sludge was spread over the surface instead. This effort was hindered by the large number of rocks and boulders on the site. The sludge itself was only partially stabilized since the aerobic digester at the Aspen Metro plant was not properly operating. This condition led to septic conditions, and resulted in odor complaints from nearby residents.

Prior to the winter of 1975-76, significant improvements in the sludge handling operation were made. Trenches were constructed to facilitate the winter disposal of the stabilized sludges and operation of the aerobic digester has been improved. This latter development has enabled sludge hauling to be reduced by one-third. Finally, lysimeters have been installed at varying depths around the disposal site, to monitor for possible groundwater contamination. However, percolation into them has been so minimal that samples have not been obtained.

Summary--Compliance with Current and Future Legal Limitations

The Aspen Plant, the Aspen Metro Plant and the Snowmass Treatment Plant are all currently providing a high degree of treatment and are usually in compliance with their current State wastewater discharge permits. Snowmass is the main exception to this statement since it is periodically in violation of its suspended solids limitation. As discussed earlier, in the Water Quality Goals section, the Roaring Fork River Basin Plan developed and assigned discharge allocations for biological oxygen demand, suspended solids and ammonia-nitrogen parameters. More stringent discharge requirements for these parameters will be applied in both 1977 and 1983. Except for the ammonia-nitrogen and residual chlorine parameters, these three plants would currently meet most of the 1977 discharge permit requirements. Compliance with these requirements is summarized in Table I-20, along with projected compliance with 1983 requirements. By 1983 not many of the requirements would be met by the existing facilities.

NONPOINT SOURCE RUNOFF

The nonpoint sources of pollution for Aspen and Snowmass include urban runoff, agricultural runoff and runoff from ski areas and construction sites. Wright-McLaughlin Engineers have evaluated the urban and construction-related runoffs and have predicted their annual output (Feb. 1975, Nov. 1975 and Dec. 1975). Their analysis is summarized in the text that follows, accompanied with EPA recommendations.

Aspen Urban Runoff

Although the Aspen and Aspen Metro sewage treatment plants are the only significant point sources of pollution, several discharges from nonpoint sources are identified in the basin plan. These sources are directly associated with urban water runoff from the City of Aspen. They are discharged to the Roaring Fork River by way of the Mill Street storm sewer, the Original Street storm sewer and the Monarch Street storm sewer. Only wastewater from the Mill Street storm sewer is treated to any degree, and this is accomplished by a detention pond that allows only for sedimentation. Wright-McLaughlin Engineers have carried out fairly extensive investigations into the quantity and quality of these types of runoff and have provided suggestions for their control.

As expected, runoff from rainfall and snowmelt becomes contaminated to varying degrees with pollutants associated with normal urban activities as it makes its way across rooftops, gutters, pavement, and lawns. Traffic, air pollution, animals,and humans and general urban activities continually provide a source of pollutants to be picked up during the next runoff event; the primary pollutants of concern are similar to those found in normal sanitary sewage although perhaps in more dilute concentrations. Stormwater runoff is particularly damaging to the receiving stream quality because it generally occurs in large volumes and thus produces a "shock loading" effect. In a mountain climate like Aspen's, the situation is further aggravated due to long periods of pollutant accumulation during the winter months. The effect of the spring washoff is further increased since snowmelt occurs earlier in the Aspen Valley than in surrounding mountain areas and, therefore, the dilution and assimilation capacities of the Roaring Fork are at their lowest.

To bring this pollutant source into the proper

TABLE I-20

SUMMARY--COMPLIANCE OF ASPEN, ASPEN METRO AND SNOWMASS TREATMENT FACILITIES WITH CURRENT AND FUTURE PERMIT CONDITIONS

	BOD_5	Suspended Solids	(Fecal Coliforms) Disinfection	NH_3-N	Residual Chlorine
Aspen Sanitation District Plant					
Current	Yes	Yes	Yes	--	Yes
1977	Yes	Yes	Yes	No	No
1983	No	No	Yes	No	No
Aspen Metro District Plant					
Current	Yes	Yes	Yes	--	Yes
1977	Yes	Yes	No	No	No
1983	No	No	No	No	No
Snowmass Plant					
Current	Yes	No-- (periodically)	Yes	--	No
1976	Yes	No	Yes	No	No
1983	Yes	No	Yes	No	No

perspective, it is helpful to bring out a comparison between it and the already known point sources in the area. Data based on primary storm sewer sampling and computer investigations by Wright-McLaughlin Engineers indicate storm runoff from the highly urbanized portions of Aspen currently produces more than twice as much suspended solids and one-third as much BOD loading on an annual basis as do the combined flows of the ASD and AMSD treatment plants (Table I-21). Therefore, urban runoff from the Aspen area is both significant and potentially damaging to the water quality of the Roaring Fork and its tributaries.

Additional nonpoint sources will be identified in the 208 areawide planning study, now in progress. After this study is completed, more definitive recommendations can be made as to the control of these sources, including urban runoff. Such recommendations could include the use of the existing ASD plant for treatment of Aspen's urban runoff.

Snowmass Urban Runoff

Recent investigations into the urban storm runoff from Snowmass indicate the contribution of pollutants carried with this flow is indeed quite significant. This contribution has been extensively discussed and documented in the Snowmass Runoff Management Plan (Wright-McLaughlin Engineers, Feb. 1975) and in the CSU-Pitkin County Environmental Resources Analysis (Lautenbach, et al., 1974).

A water quality testing program in the Brush Creek basin was conducted in the spring of 1974 (Table I-10). These results suggest that although turbidity from natural sources may be somewhat higher than in some other areas, due to Mencos shale outcroppings, the major portion of the Brush Creek basin does not contribute a significant loading turbidity and suspended solids. However, at the confluence of Brush Creek and the Roaring Fork, Brush Creek was found to be excessive with respect to suspended solids and only marginal with respect to Chemical Oxygen Demand (COD). This disparity was explained in the Runoff Management Plan (Wright-McLaughlin Engineers, Feb. 1975) by suggesting that the additional suspended solids came from the runoff from West Village and the Middle Fork of Brush Creek. In the latter case, it was concluded that high suspended solids concentrations were related to ski slopes and associated facilities.

To further clarify the magnitude of the storm water runoff problem, the basin was modeled on a computer using the "STORM" program developed by the Corp of Engineers. The results of this effort suggested that suspended solids from storm runoff are significantly degrading the basic water quality of Brush Creek. To further put this in perspective, it was estimated that on an annual basis the runoff contribution (115,800 lbs.) would be more than 316 times the loading of solids contributed by the only point source — the Snowmass sewage plant (31,800 lbs.). Thus, it is apparent that in order to maintain a cost-effective approach and to maintain the desired water quality goals, treatment of urban runoff should be initiated.

TABLE I-21

COMPARATIVE POLLUTANT LOADINGS URBAN RUNOFF VS. POINT SOURCE

	BOD (lbs/yr)	SS (lbs/yr)
Current Point Source Discharge[1] (Aspen and Aspen Metro Plants)	122,000	122,000
Nonpoint Source (Storm Model-Urban Runoff, Aspen Study Area — Present Development)	44,000	270,000
Ratio (Nonpoint/Point Source)	0.36	2.21

---

[1] Assuming 2.0 mgd Flow with a 20 mg/ℓ. suspended solids and BOD concentration.

WATER SYSTEM MANAGEMENT

An entire district water system essentially acts as an interrelated drinking-water supply and sewage-treatment system. The key to its success is efficient system operation, conservation of water and reduction of infiltration into the collection system. Conservation of water is partially a function of cost and general public awareness. If public awareness does not curtail consumption, then installation of water meters may. Infiltration into a collection system creates additional wastewaters to be treated at the sewage treatment plant. It also reduces overall treatment efficiency. If infiltration in a particular system is found to be excessive, it must be determined whether it is less costly to reduce infiltration or to treat additional flows. All of these factors are discussed in the following paragraphs, under the headings of Aspen water supply, Snowmass water supply and system material balance.

Aspen Water System

The water requirements of the Aspen study area are supplied primarily by the Aspen municipal system along with two much smaller systems, the Highlands system and the White Horse Springs system. Private wells are also used for water supply at some residences. Principal uses for these waters include normal potable and domestic uses, plus lawn irrigation.

The Aspen municipal system serves most of Aspen metro area including Red Mountain, the City of Aspen and an area extending from the Mountain Valley Development on the south to Sardy Field. This system obtains raw water from both Castle and Maroon Creeks, which is then piped to the treatment plant on Castle Creek Road. The present water treatment plant has a capacity of 8 mgd and the needs of the service area are approaching that capacity. The city has more than adequate water rights to meet future needs on these streams, plus additional rights on Hunter Creek and the Roaring Fork itself. The operation of the treatment plant has been controlled so that wastes from filter back-flushing are not discharged to streams in any significant quantities. During the summer these wastes are sent to ponds and then used for irrigation; in the winter wastes of this type are minimal.

The water supply for the Highlands area along Maroon Creek is provided by the Highlands Water and Sanitation District. Maximum diversion for this system is about 0.06 cfs or 0.039 mgd. Likewise, the White Horse Springs system serves a small area in Starwood.

The City of Aspen is currently planning two programs which will eventually reduce overall waste loadings and hydraulic loadings to the treatment facilities. First, they have passed a city code that will provide for mandatory metering of all Aspen water taps within five years. Current data indicate consumption is less in metered areas, and the metering program should decrease overall water usage and flow to the sewage treatment plant.

Second, studies conducted by Wright-McLaughlin Engineers concerning infiltration/inflow into the metro collection systems indicate that significant quantities of water are entering the collection system during periods of high groundwater tables. The quantities amount to approximately 140 million gallons annually and usually occur during spring runoff or irrigation seasons. Poorly sealed or cracked joints, manholes, and cracked pipes are primary points of this infiltration. It is estimated that 50 to 70 percent of this infiltration could be eliminated by a sewer rehabilitation and maintenance program, which would result in the delay of capital facility expansion and reduced O/M costs. This approach would allow for the optimum utilization of the treatment facilities and is judged to be cost-effective by Wright-McLaughlin Engineers. Therefore, the City of Aspen has proceeded to implement such a program.

Snowmass Water System

The Snowmass Water and Sanitation District currently has a raw water treatment capacity of slightly more than 3.9 mgd, using a treatment plant located just south of West Village. The present raw water supply is normally taken from East Snowmass Creek by transbasin diversion. This water is transported via the East Snowmass Creek and Brush Creek Ditches. East Brush Creek can also be diverted to the plant but this is not often done. Diversion of Brush Creek is done only occasionally when water from East Snowmass Creek is very turbid. The district has acquired additional water rights from the East Snowmass Creek Basin and plans to provide additional capacity from this source in the future. The operation of the treatment plant directs backwash water from the sand filters into a settling pond, where it overflows into Brush Creek.

Principal uses for the Snowmass water include normal domestic uses in the condominium developments and normal supplies for the West Village and Restaurant areas. Irrigation of the Snowmass Golf Course is practiced during the summer months; however, water from Brush Creek is utilized for that purpose.

Wright-McLaughlin Engineers have conducted a fairly extensive study into the infiltration of the Snowmass system. It was found that peak flows to the sewage plant occur during the spring runoff period of April and May, when the number of users in the Snowmass area is the lowest. The plant was severely hydraulicly overloaded at this point. Infiltration rates were found to be approximately five times that normally allowed and sometimes comprised 80 to 90 percent of the total flow to the treatment facility. A comprehensive program to control this infiltration flow is recommended and could result in a 50 to 70 percent decrease in infiltration, especially important in the spring. Such a program would make the spring sewage flows of 1977 less than the sewage flows from the winter population of 1977 and 1978. However, these winter flows would exceed the current design capacity and provide support for the proposed expansion.

System Material Balance

The material balance for the study area compares the domestic raw water entering the system with the wastewater leaving it. These entities are approximately equal for the Snowmass system but not for Aspen's. Here, a consumptive use of incoming water reduces the amount flowing out. Approximately 3.0 mgd was supplied to this system during the 1975 winter although only 1.38 mgd was routed through its sewage treatment works (Wright-McLaughlin Engineers, Dec. 1975). The resulting loss from the system cannot be explained with existing information and requires more study for clarification.

II.

OTHER EXISTING ENVIRONMENTS

The existing environment of the project area is described in a variety of other reports and is not repeated here in detail. All too often, such an approach turns into a report that reads like a textbook, recapitulating all known facts regardless of how obscure or unrelated to the proposed action. It is virtually impossible to write an EIS that explains all factors to the satisfaction of all reviewers. Thus, value judgments have been made regarding topic priority and detail. The judgments have resulted in a brief summary of the area's major features, with special emphasis on aquatic, population and land use factors. This discussion is divided into elements of the natural and man-made environments.

NATURAL ENVIRONMENT

Elements in this section include geology, soils, biology, climatology and air quality. Because the theme of this statement is wastewater control, emphasis is placed on aquatic biology and those elements that must be considered in conjunction with possible land application of treated sewage effluent. Land application, per se, is under active consideration and is discussed in the description and evaluation of alternatives sections.

Geology

Powerful forces of gravity and heat have formed and shaped the rugged terrain around Aspen, making it one of the most beautiful settings in the world. The current mountain ranges began their uplift about 60 million years ago and have been folding and faulting ever since. Their surface features have been altered by the gravity flow of snow, ice, water and rocks and by wind and water erosion. These actions eventually manifested themselves in the glacial movements of the last million years, and were especially influential in carving Aspen's mountain sides and U-shaped valleys. In their aftermath they left numerous terraces, comprised of rocks and boulders of all sizes. Streams cut through these deposits and formed their present-day channels.

The materials in these channels are called alluvium because it contains unconsolidated rock fragments that have been deposited there by water. Part of the Snowmass' sewage works and most of Aspen's sewage works are located on this alluvium, within the 100-year floodplain. Its location could be expected to be flooded with an average frequency of once in one hundred years.

Although the alluvium is prone to erosion, espcially erosive material is found along the banks of Brush Creek, called Mancos Shale. It is a deposit of ancient lakes or seas and is usually olive gray in color. This shale can erode when its vegetative cover is removed and is responsible for much of the high sediment yield of Brush Creek. Other features of Mancos Shale include variable permeability and a high shrink-swell potential, which makes it undesirable as a construction surface.

Soils

The soils of the project area are important for the role they could play in the land treatment alternative. Their various properties and characteristics have been classified by the U.S. Soil Conservation Service (SCS) and they have been mapped for the project area (Lautenbach et al., 1974). An inspection of this map indicates major types that could be impacted by land treatment. These types are listed in Tables II-1 thru II-3 for Aspen and Snowmass, and they are classified with regard to agricultural suitability. These suitabilities have been arranged into eight classes and four subclasses. Only four of those classes and three of the subclasses appear in the project area, all of which are described below.

- Class III—These solids are the best of the soils in the project area, yet they may possess any of the following restrictions: moderately steep slopes, high erosion potential, potential water overflow, slow permeability, shallow soils, low fertility and moderate salt accumulations.
- Class IV—These soils are suited to even fewer varieties of plants than those in Class III and the restrictions are more severe.
- Class V—Soils in this class have little or no erosion potential but are limited to use as rangeland, grassland or wildlife habitat. They may occur in bottomlands, have rocky soils or possess drainage problems.
- Class VI—These soils are poorly suited for cultivation but they can be productive if they are carefully managed. They may possess any of the following limitations, which are difficult to correct: steep slope, severe erosion, effects of past erosion, stoniness, shallow rooting zone, excessive wetness, low moisture capability and possible salinity constraints.
  - Subclass e—Erosion by wind or water is the major problem.
  - Subclass w—Major constraint is excessive water expressed as wetness, overflow or high water table.
  - Subclass c—Climate is the major hazard; in the Steamboat Springs area this hazard is usually expressed as lack of moisture.

Since those soils proposed for land treatment are currently being irrigated, their suitability

TABLE II-1

LAND TREATMENT SOILS FOR ASPEN

Mapping Unit	Series	Agricultural Suitability	Texture	Slope (%)	Permeability (in./hr.)
28 C D E	Zillman Complex	Restricted, SCS Class VIe Restricted, SCS Class VIe NC[1]	Stoney loam surface, over stoney clay and stoney loam subsurface	0-6 6-12 12-25	0.6 to 6.3
29 F	Unnamed	Unsuited	Loam to sandy loam surface over loam subsurface	25-65	0.6 to 6.0
32 B C D E	Unnamed	Restricted, SCS Class IVe Restricted, SCS Class IVe Restricted, SCS Class IVe NC	Loam to sandy loam, sandy loam to clay loam subsurface	0-6 0-6 6-12 12-25	0.06 to 6.3
37 D E	Anriano	Restricted, SCS Class IVe NC	Loam surface, over clay loam substratum	6-12 12-25	0.2 to 2.0
46 D	Gothic	Restricted, SCS Class IVe	Loam to silty clay loam surface, over silty clay	6-12	0.1 to 2.0
52 VC	Jodero	Restricted, SCS Class IIIe	Loam surface over sandy clay loam	0-6	0.3 to 2.0
55 D E	Arle	Restricted, SCS Class IVe NC	Loam surface over gravely loam	6-12 12-25	0.06 to 6.0
70 D E	Unnamed	Restricted, SCS Class IVe NC	Loam to silt surface, over clay to silty loams	6-12 12-25	0.2 to 2.0
86 F	Jerry	Restricted, SCS Class VIe	Loam surface, over gravely clay loam	12-25	0.3 to 2.0
156 D	Acree	Restricted, SCS Class IIIe	Loam surface over clay to clay loam	0-12	0.1 to 2.0
170 C D	Unnamed	Restricted, SCS Class IVe Restricted, SCS Class IVe	Loam surface over loam to clay loam	0-6 6-12	0.1 to 2.0

---

[1] Not Classified.

TABLE II-2

LAND TREATMENT SOILS FOR BRUSH CREEK

Mapping Unit	Series	Agricultural Suitability	Texture	Slope (%)	Permeability (in./hr.)
X8 C	Unnamed	Restricted, SCS Class VIw	Loam to clay loam	0-6	0.2 to 0.8
46 D	Gothic	Restricted, SCS Class IVe	Loam to silty clay loam	6-12	0.6 to 2.0
56 D	Burnette-Libeg Association	Restricted, SCS Class Vc	Stoney loam to stoney clay loam	6-12	0.6 to 2.6
146 D	Moundaly	Restricted, SCS Class IVe	Clay loam to clay	6-12	0.01 to 0.2

TABLE II-3

LAND TREATMENT SOILS FOR OWL CREEK

Mapping Unit	Series	Agricultural Suitability	Texture	Slope (%)	Permeability (in./hr.)
56 E	Bigel Argic	NC[1]	Stoney loam to stoney clay loam	12-25	0.6 to 2.6
93 C	Aspen-Gypsum	Restricted, SCS Class VIw	Silty clay loam, clay loam and sandy loam	0-6	0.2 to 6.0
146 C D	Moundaly	Restricted, SCS Class IVe Restricted, SCS Class IVe	Clay loam to clay	0-6 6-12	0.01 to

[1] Not Classified.

is already demonstrated. However, due to the possible change in the water's nutrient and mineral content, application rates might have to be modified. This would have to be determined at a future date after individual conferences with the various water users. The application rates would have to be adjusted to minimize salt buildup, trace metal accumulations, and prevent leaching of excessive nitrates to groundwaters. The details of these considerations are discussed in the evaluation of the alternatives.

Biology

The biological environment is especially important in an aquatic sense since both point and nonpoint discharges affect its quality. The terrestrial biology is less important and is not discussed here, although the reader may refer to Lautenbach et al.(1974) for details about its character. The aquatic discussion is divided into sections on plants, insects and fish and it considers the ramifications of water quality on the organisms' health. This discussion is followed by one on rare and endangered species.

Aquatic: The aquatic biology of the project area is characterized by snow-fed trout streams that flow into the Roaring Fork River. These streams are shown in the hydrology map of Figure B. They have been modified by human presence, through the construction of roads, nearby residential communities, sewage plants and mines. The result has been a slight change in water quality and probably a change in the relative abundance of stream organisms. Despite these changes, though, the major types of organisms have probably remained the same.

The plants of the streams are generally contained in a film on the bottom called periphyton. This film not only contains plants but also bacteria, fungi, tiny animals and the tissue of a multitude of dead organisms. This dead tissue usually makes up the majority of the film's substance and is actively eaten by the bacteria and animals. The plants are small organisms called green algae, yellow-green algae, blue-green algae and diatoms. They account for the majority of plant production that occurs within the streams' boundaries. This production is further augmented by larger plants, rooted in the streams' rocky bottom, and terrestrial vegetation that is swept into the streams by wind and water.

The health of the aquatic plants is related to stream water quality and, especially, nutrients like nitrate and phosphate. These nutrients act as chemical fertilizer for the plants, but at higher concentrations they stimulate excessive algal growth. When this occurs, the algae eventually die and excessive bacterial growth results, which can reduce a stream's oxygen content. The appropriate concentrations for these nutrients has not been determined but the EPA is in the process of modifying the test used to assess nutrients in lakes, so it can be applied to streams. When this modification is made, tests will be run on the Roaring Fork River and Brush Creek, and safe levels of nitrate and phosphate loading will be developed.

The insects in the project streams are a primary source of food for trout; these insects feed on periphyton, organic matter suspended in the stream, and sometimes each other. They are comprised largely of mayflies, caddisflies, stoneflies and two-winged flies. An individual of any of these types is born in the water and develops among the stream's rocks and rooted aquatic plants. When it reaches adulthood, it leaves the stream, becomes airborne and mates.

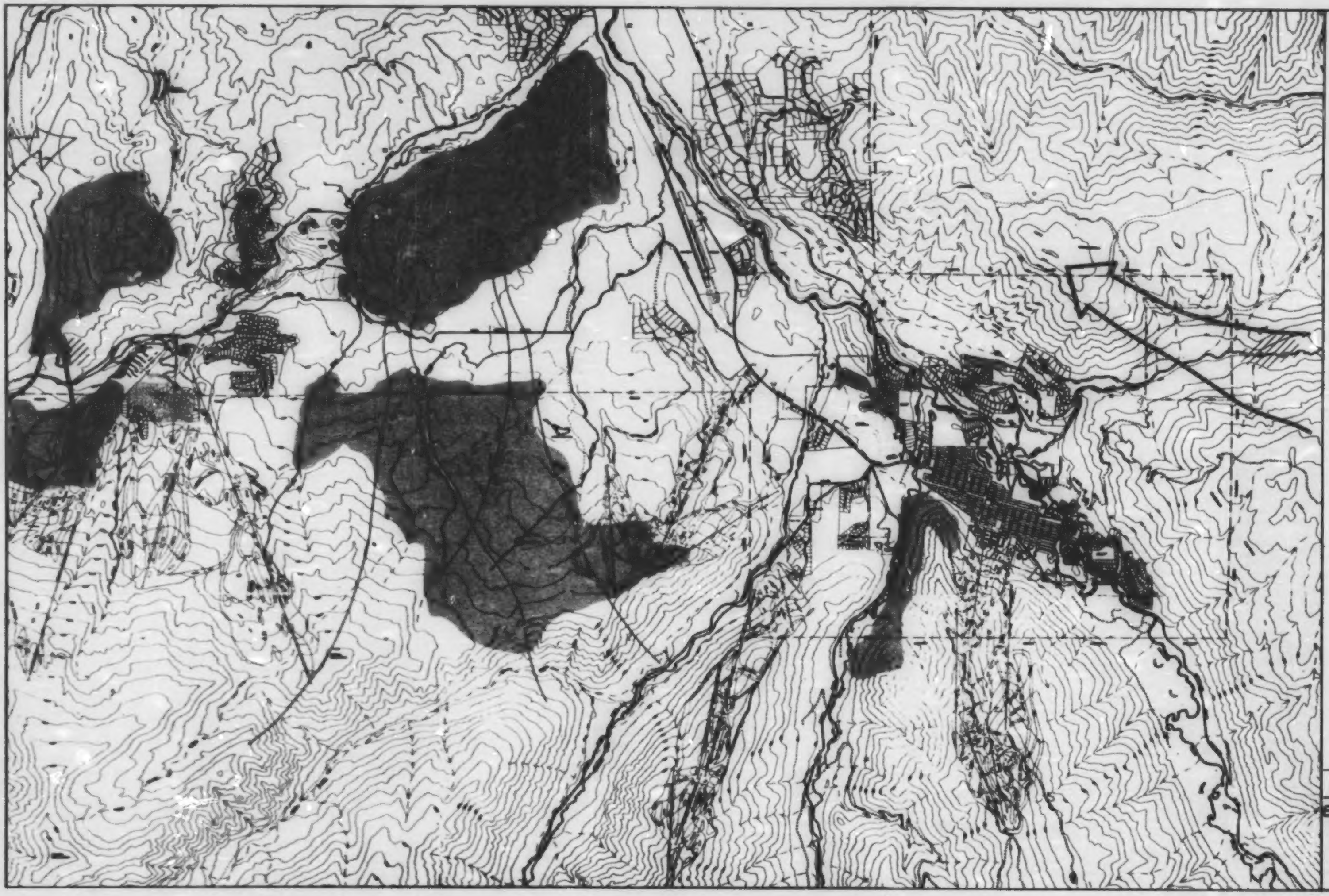
Many factors of water quality affect the abundance and diversity of these aquatic insects. Nutrients that stimulate plant growth, like phosphates and nitrates, can increase their food supply and stimulate their growth. Other factors, like suspended solids, can clog their gills and smother their developing young. This condition is especially prevalent in Brush Creek, due to excessive natural runoff and some urban runoff.

Trout are the most popular and well-known fish of the streams in the project area. They occur in several varieties but only one of them, the Colorado cutthroat trout (*Salmo clarki pleuriticus*) (Bhenke, 1976), is native to the area. This trout once lived in all the streams of the project area; however, the introduction of other cutthroats, competition from other trout and human activities have reduced its distribution to a few isolated individuals. The introduced cutthroats came from Yellowstone Lake in Wyoming and were transplanted to Colorado between 1900 and 1950 (Bhenke, 1976). They interbred with many of the remaining Colorado cutthroats and created a hybrid strain of cutthroat. Rainbow trout may also have interbred with this Colorado cutthroat, reducing its number of pure individuals even further.

Competition with the Colorado cutthroat could have come from rainbow, brook and brown trout, all of which are introduced trout. The rainbow and the brown trouts are the most plentiful in the Roaring Fork River although brook trout may also be found there; Brush Creek is known to support brown and brook trout. All of these trout depend on aquatic insects for their food and they supplement this diet with terrestrial insects blown into the water, as well as algae, zooplankton, crustacea and other fish.

The health of these trout is further dependent on the quality of the water, especially in regard to dissolved oxygen, suspended solids, ammonia and residual chlorine. The dissolved oxygen levels are above the state's standards for B_1 streams and are generally good. Suspended solids are particularly high in Brush Creek, where they loom as a potential problem. They develop their impact by clogging gill filaments and reducing the necessary gaseous exchange or "breathing". These solids can also cover nests of fish eggs and smother the developing young. However, since trout have been living in Brush Creek for years, their tolerance to suspended solids is proven (Gerbaz, 1975).

The toxicity of ammonia to fish is dependent on its un-ionized fraction (NH_3). The *concentration* of this fraction depends on concentrations of total ammonia, background pH, and temperature. *Toxicity* of ammonia is also influenced by alkalinity, dissolved oxygen, free carbon dioxide, sodium ions, total dissolved solids and the presence of other toxins. EPA believes that the safe maximum level of un-ionized ammonia is 0.02 mg/ℓ (NH_3-N) in order to protect fisheries. Above this level gill tissue is harmed and the excretion of nitrogen-containing wastes is impaired (Willingham, 1976). The toxicity of chlorine to fish



STUDY MAP 4

POTENTIAL GEOLOGIC HAZARDS

aspen-snowmass

wastewater treatment facilities
environmental impact statement

☆U.S. GOVERNMENT PRINTING OFFICE: 1976—678-153

44-A

depends on the amount of residual chlorines in the water, found as free chlorine or bound chlorine. The most commonly-known bound form is the chloramine, which is believed to be slightly less toxic than the free form. Both forms should possess a combined concentration of 0.003 mg/ℓ or less, according to the recommendations of Quality Criteria for Water (EPA, unpublished). This concentration should protect the trout of the study area, as well as its other aquatic organisms.

Urban runoff has already been previously described but it contributes many substances that can be directly toxic to trout, chiefly suspended solids and ammonia. Other substances like BOD can encourage the growth of bacteria, which can decrease the streams oxygen concentrations. A combination of these factors may have been responsible for a fish kill in the Roaring Fork River in 1973. Since that time, however, steps have been taken to alleviate the problem by installing a runoff settling basin. This step only represents a beginning though, and more needs to be done to eliminate this hazard to aquatic life.

Rare and Endangered Species: Several types of organisms have been designated as rare or endangered by the U.S. Department of Interior. A rare species is one whose survival is threatened because of its low population numbers. When a rare species has even fewer numbers, and its survival is in immediate jeopardy, it becomes an endangered species. The rare species that have been known to occur in Roaring Fork basin include the Colorado cutthroat trout (Bhenke, 1976) and the prairie falcon (Lautenbach, et al., 1974). The Colorado cutthroat trout (*Salmo clarki pleuriticus*) has been found in Nickleson and Cunningham Creeks (1972 and 1973) and has been identified by Dr. Bhenke of Colorado State University. This trout prefers cool, clear water and is extremely susceptable to changes in water quality or stream habitat. It is the only native trout to the study area and it fares poorly in competition with other trout species. It also is believed to hybridize with rainbow trout and other types of cutthroats trout. The endangered species of the county include the southern bald eagle and the peregrine falcon (Lautenbach, et al., 1974). The status of the bald eagle may be improving, however, and several environmental groups are arguing for its removal from the endangered list (Audubon, 1976). The peregrine falcon has been sighted near the red bluffs beside Highway 82, near the town of Snowmass (Whitaker, 1976).

Climate

The climate of the study area has been described extensively in other reports and is not repeated here. If readers desire this information, they may consult Preliminary Environmental Impact Analysis of the Proposed Pitkin County Light Rail Transit Study (Weiner and Associates, 1976) or Environmental Resources Analysis, a Tool for Planning (Lautenbach, et al., 1974).

Air Quality

The most important air quality parameter for the project is odor. Additional parameters are discussed in other reports and are not repeated here. These reports include Pitkin County Air Quality Impact Report (S. Weiner, Colorado Air Pollution Control Division, 1973), Environmental

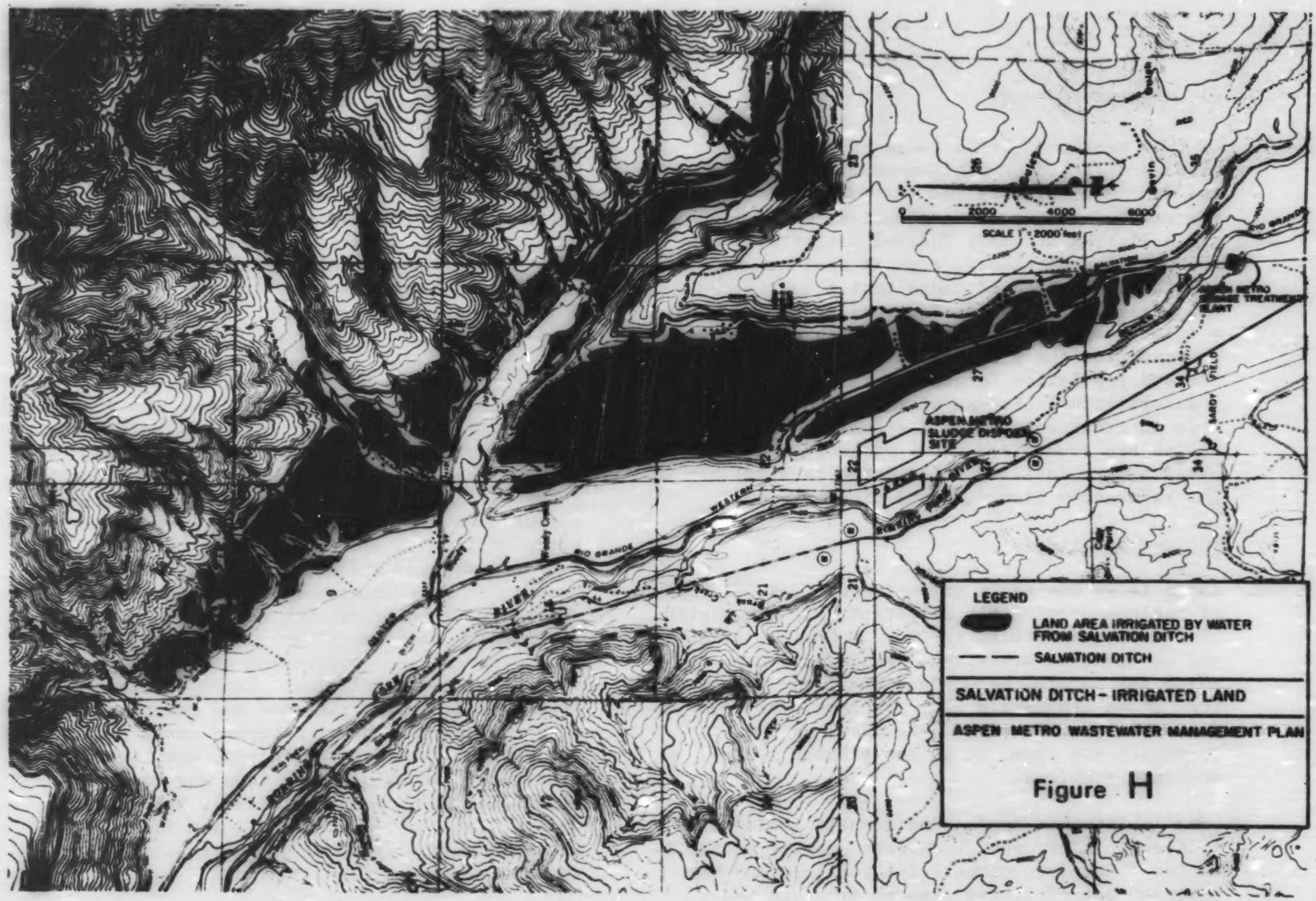
Impact Assessment Report, Aspen-Pitkin County Airport (W. Marlatt, 1974), An Analysis of the Air Pollution Potential of Owl Creek Valley, Pitkin County, Colorado (W. Marlatt, 1974), the Air Pollution Carrying Capacities of Selected Colorado Mountain Valley Ski Communities (Colorado Air Pollution Control Division, 1974), plus the two reports mentioned under Climate.

When sewage treatment works are proposed in new locations, odor potential usually stimulates local emotions and causes public concern. The present Aspen Metro site minimizes this concern because of its isolated location. This plant is not only out of view from most directions, but the steep embankments of the Roaring Fork drainage at this point also provides a natural barricade against odors. Due to the modern design of this plant, odors normally can be limited to the immediate area of the polishing pond and within the treatment building. During upset conditions, wind drainage along the river should provide ample dilutions and dispersion so that present and expanded future operations are not considered odor hazards.

The Mill Street plant is located adjacent to the main business center of Aspen and falls under continuous public scrutiny. This plant is the oldest of the three plants in the study area and includes some components (trickling filter) that are susceptible to becoming partially anaerobic. This condition leads to significant odorous conditions, according to nearby long-term residents, and it has caused periodic odor problems ever since the plant was built. One nearby resident, Judy Capparella, describes the odors as "terrible" and occuring frequently during the 17-year history of the plant. However, the addition of the Aspen Metro plant has allowed for major operating improvements in the Mill Street plant (MSP) due to the interceptor sewer connecting the two plants. This connection has allowed the MSP to operate with a uniform flow which has resulted in a more efficient operation, higher quality effluent, and significantly reduced odor emissions. According to Mrs. Caparella, no odor problems occurred during the 1974-75 winter, 1975 summer, nor during the 1975-76 winter seasons.

The Snowmass plant is isolated from the community by a golf course. Odors have been successfully limited to within the treatment building and occasionally along the perimeter of the polishing pond. According to employees at the nearby Snowmass Country Club, plant odors have never been a problem, nor have golfers' complaints been received.

The sludge disposal site indicated on Figure H has been a source of odor complaints by neighbors 200 yards to the northwest. Until recently poorly digested sludge was being spread over the site. Rocks and boulders prevented the trenching of sludge as planned so that odors resulted, particularly in the spring as the ground thawed and biological decomposition increased. Both of these situations have been rectified and odor problems should be prevented in the future.



LEGEND
LAND AREA IRRIGATED BY WATER FROM SALVATION DITCH
SALVATION DITCH
0
2000
4000
6000
SCALE 1" = 2000 feet
ASPEN METRO SEWAGE TREATMENT PLANT
ASPEN METRO SLUDGE DISPOSAL SITE
SANDY FIELD
RIO GRANDE
WESTERN
RIVER
Woody Cr
Brush Creek
21
22
23
26
27
34
35

SALVATION DITCH - IRRIGATED LAND

ASPEN METRO WASTEWATER MANAGEMENT PLAN

Figure H

MAN-MADE ENVIRONMENT

In this section a broad range of topics is discussed including socio-economics, population and land use, history and archaeology, public recreation, transportation, noise, solid waste, and a listing of other federal projects in the study area. Certainly, a great deal can be written about each of these topics due to the uniqueness of the Aspen-Snowmass area. However, a value judgment has been made regarding topic priority for the projects being proposed. Land use and population forecasts are presented in greatest detail because of their fundamental role in treatment facilities design. Other topics are summarized for brevity's sake, and because more detailed information is available in the references listed in the bibliography.

Socio-economics

Aspen is in one sense an exclusive town, a product of socio-economic self selection. It seems proud of its non-conformist style in behavior, dress, and in economic activity. People move here to enjoy the natural beauty and small town setting. They leave behind big city problems, yet enjoy a cosmopolitan life-style. As ideal as this community may seem, it is not without socio-economic problems.

Some insist that Aspen's uniqueness includes a fellowship among residents which defies categorization. However, competition for jobs and the intense cost of living creates pressure and frustration for many. Inexorable economic pressures, high resort prices and a constant influx of youth and "hideaway rich" have driven the marginal segment of the population, the old, sick, poor, or unskilled, out of the community. Remaining residents strive to preserve the charm and quality of Aspen's pleasures, but efforts are frustrated by their own differences of opinion. In addition, the same appeal which they are trying to preserve, also serves as a magnet attracting new residents to the area. This attraction is considered a threat by local observers due to the growth implications.

Aspen rejected another unwanted class, the land developer, although both sides have won victories and skirmishing still continues. Almost without exception, the residents of the Aspen community have reached a consensus supporting a controlled growth policy, recognizing that it will assure a continued high quality of life — an Aspen style of life -- and continued economic prosperity based on tourist/skier spending. Thus, Aspen presents the anomaly of resident land owners and developers, who have lost potential fortunes through controversial downzoning of their resort land, expressing general agreement with slow growth policies. Those developers from outside Aspen, the land and resort speculators who have bought or optioned large tracts for maximum development profits, are harrassed, frustrated, and blocked by town and county officials, using new regulations, bureaucratic delays, and the limits of official power, all with the hearty approval of the insular Aspen community.

The other participants in the Aspen scene, in but not of, the community, are the tourists who provide the economic base for Aspen's only industry. Flocking in numbers which double the permanent (i.e., those who live for a year in Aspen) population, the tourists are often viewed condescendingly as "turkeys", an unstylish and rather inferior form of bouregois, but necessary to the well-being of the mercantile sector and its work-play force.

Demographic Information: Pitkin County is located in the western center of the state of Colorado. The County covers 974 square miles and the land ownership is divided into the following acreage: private, 110,172, federal, 492,345; state 640; and county and municipal. 1,050. The terrain is mountain valley and the major source of income because of its rural, but non-farm nature, is tourism.

Overall the population in Pitkin County consists of persons not born in Colorado, having a higher than average income, and who are the most highly educated in the state. The majority of people are in the 18-64 age group, with a lower than average number under 18, and significantly few people over 65 -- nearly three times less than the state average. Finally, there are far fewer children being born to women of child bearing age than the state's average. The following statistics and other data illustrate these observations.

Because of the small populations of its towns, Pitkin County is described by the U.S. Census as entirely rural. However, the percentage of people employed in agriculture dropped from 28.2 in 1950 to 5.5 in 1970.

Pitkin County retail sales were $77,124,278 for the fiscal year ended June 30, 1974. Aspen accounted for $55,792,645; Snowmass for $1,554,707, and the remainder of the county for $19,776,926. The Aspen retail sales accounted for 0.62 percent of the state tax total.

In the 1970 Census, less than one-third of the population (30.9 percent) claimed they were residing in their state of birth. This compares with a 46.4 percent state average and attests to the many out-of-staters and/or former tourists choosing Aspen as a desirable place to live. Pitkin County's estimated population of 15,100 in 1975 makes it the fastest growing county in Colorado, even though it ranked 45th in population (of 63 counties) during the 1970 Census.

The mean income for Pitkin County as stated in the 1970 Census was $14,541, the second highest county income in the state which has a mean of $10,875. Median income for Pitkin County is $11,763, also well above the state median of $9,555. Pitkin is one of eight counties, of the 63 Colorado counties, having the lowest proportion of families with below poverty-level incomes (only 5.7 percent compared to 9.1 percent for the state). Moreover, of Colorado's counties, Pitkin has the second highest percentage of families with income exceeding $15,000. One-third of all Pitkin County residents fall in this category, while the state average is 19.7 percent.

The median education level of Pitkin County residents is 14.4 years, which is the highest in the state (12.4 years) and 1.6 years above the next highest county.

The minorities in Pitkin County are so small in number that they do not even statistically amount to a "group". That is, the Black and Spanish-speaking elements of the population were less than one percent in 1970, far below the Colorado average.

Pitkin's percentage of people under 18 years of age is 30.8 percent, which compares to 35.1 percent for the state. Accounting in part for this is the low fertility ratio, i.e., children under 5 years per 1,000 women 15 to 49 years of age. Pitkin county is second lowest at 257 compared with Gunnison's 217 (the lowest because Western State College's students account for the majority of the county's population) and the state's 340, while the state percentage is 56.4. Most notably small is the percentage of people over 65. This age group accounts for 8.5 percent of the state's population, but only 2.8 percent of the Pitkin County population.

Population and Land Use

Aspenites agree that the most significant issue facing the community is pressure for growth and development. Therefore, a major goal in preparation of this EIS was to develop population projections which best reflect the attitudes of a cross-section of the resident population, local officials, and development interests. The method used relied heavily on the results of nearly 70 interviews of people from the above groups. The physical limitations of available land and historic trends were also studied in the absence of local, regional or state population forecasts. The results of the EIS effort have been presented to local interests, who have concurred with the projections developed.

Growth: Perhaps more than any other issue in the area, the residents of Pitkin County are concerned about the rate of population growth. Pitkin County's population even until the 1960s, was very low in relation to present numbers. However, during the decade came the condominium, the growth of skiing, popularity of camping, and the development of cultural activities which have attracted increasingly large numbers of tourists and permanent residents seeking to avail themselves of the many amenities offered by the Aspen/Snowmass area. In the past five years the growth has become substantial (11 to 14 percent; Gilmore and Duff, 1974) and many residents and elected officials assert that continuation of these trends will soon destroy the unique quality that originally brought them all to Pitkin County. They have sought, therefore, to control the level and type of growth in the area.

It is very difficult to determine the existing population of Pitkin County for a number of reasons. First, it has been more than five years since the last U.S. Census, and the almost phenomenal recent growth renders these latest "official" figures rather useless. The recently established Northwest Colorado Council of Governments has not estimated present population for the area or individual counties. The federal government's OBERS projections and the Colorado State Planning Office both indicate a Pitkin County population in 1985 which is lower than the present off-the-cuff estimates given by city and county officials. Unlike most communities with industrial or service based economies, the "permanent" population of the area is extremely difficult to define. There are of course, permanent, full-time residents of the county who live and work there. But there are others: the wealthy tourist who owns a second home in the area, but lives there only part-time; the student who has taken a semester off from school to work in the area; the person who has come to Aspen to ski for an entire season, who is replaced immediately by the participant in the summer Aspen Music Festival -- neither one a full-time resident, although a housing unit is continually occupied; and the person who commutes from another city, spending every other week or every weekend in Pitkin County.

In the city of Aspen, it is estimated that the total permanent population is composed of approximately 2,600 residents, living in the 700 non-tourist units, plus an additional 3,000 persons occupying "temporary" housing within the city limits. Approximately 7,700 persons temporarily occupy the remaining "tourist pillows", for a total (permanent plus temporary) population of approximately 13,300. In the remainder of the Aspen metro service district, it is estimated that the 1,323 units are occupied by 3,900 permanent and 1,000 temporary residents. From extensive interviews with residents, city and county staff members and elected officials, a concensus with respect to the present permanent populations of Pitkin County and Snowmass is that they are 15,000 and 600 respectively. Thus, the present population of the county is distributed as follows:

	Present Population (average)		
	Permanent	Temporary	Total
Snowmass Study Area	600	4,000	4,600
Aspen Metro Study Area			
1. City of Aspen	5,600	7,700	13,300
2. Balance of Area	3,900	1,000	4,900
Subtotal, Study Area	10,100	12,700	22,800
Balance of County	4,900	300	5,200
Pitkin County Total	15,000	13,000	28,000

Ultimate population capacity is based on the build-out of present zoning capacity, plus a modest amount of new zoning which the study team considers highly likely (Study Map 2).

New zoning is likely to occur primarily in Snowmass, with limited additions at the base of Smuggler Mountain. This may also be expected at Stillwater Ranch at the southeast edge of Aspen. Additional growth, perhaps 5,000-7,000 persons, is possible in the Owl Creek development, and scattered new zoning. At the present time, the majority of the elected officials favor the lowest possible amount of growth. However, minimum growth in Snowmass is recognized to be necessary for the resort's financial integrity which is a key factor influencing the financial health of the Snowmass Water and Sanitation District. Growth is not as critical in the cases of Aspen and Aspen Metro Sanitation Districts. As discussed in the cost evaluation section, these districts are in sound financial condition and could tolerate a minimum growth rate. The ultimate projected populations are distributed as follows:

	Ultimate Population (average)		
	Permanent	Temporary	Total
Snowmass Study Area	3,000	9,250	12,250
Aspen Metro Study Area			
1. City of Aspen	13,500	5,800	19,300
2. Balance of Area	19,000	7,200	26,200
Subtotal, Study Area	35,500	22,250	57,750
Balance of County	13,000	3,250	16,250
Pitkin County Total	48,500	25,500	74,000

The rate of growth from the present to the ultimate population will be severely constrained by governmental growth controls. Although the market forces could theoretically support a continuation of past growth rates (perhaps 11 to 14 percent), constrained long-term growth will average 5 percent in Pitkin County to 1990, then be less as the logistic effect occurs (i.e., as population approaches limits set by zoning or utility services and growth slows). However, near term growth (to 1980) will average 7 percent per year.

Extensive interviews in the area do reflect a consensus that growth must be slowed from its 1973 rates and our future estimates reflect the belief that, regardless of public opinions on candidates and future political issues, Pitkin County residents in general will support efforts to control growth in the area.

While the Aspen city officials and Pitkin County Commissioners are seeking to slow growth in the Aspen area, the Snowmass service district with general concurrance of county officials is desirous of continued growth. Snowmass, established in the late 1960s, was originally conceived as a totally new planned community which would provide quality skiing, primarily for the intermediate skier. There have been many problems with the development of Snowmass as a permanent community, some related to the physical location, others to the general economy, still others to the lack of some "community" services, such as a permanent church and a supermarket. To date, most persons do not consider Snowmass a near substitute for Aspen. While it is certain to continue to grow, the degree of Snowmass' growth will be affected by many factors other than governmental policies: the general economy, its transition from a satellite of Aspen to a more permanent community, its appeal as a living location and a desirable vacation option for tourists.

Population projections are fundamental to wastewater facility planning. Where peak season forecasts are important and provide a realistic basis, engineers must also plan for peak day flow. To do this, three population elements must be considered: permanent residents, temporary occupants and day visitors. These three groups contribute different flow volumes to the system as described in the Facilities Plans. For Aspen, the present peak day flow is 2.05* million gallons per day (mgd) which corresponds to an estimated peak day population of 18,200 (permanent plus temporary) and 2,000 day visitors. In Snowmass, the present peak day flow is 0.82 mgd* with estimated peak day population of 7,700 (permanent plus temporary) and 3,750 day visitors. Ultimate peak day flow and population projections are as follows:

---

*Includes Aspen and Aspen Metro flow; sewer line inflow and infiltration (I&I) @ 0.23 mgd in December.

	1995 Peak Day Population	Flow Equivalent
Aspen	45,000 @ 90 gal/person/day (permanent & temporary)	4.05mgd
	3,500 @ 15 gal/person/day (day visitors)	0.05 mgd
		4.10 mgd
Snowmass	16,250 @ 90 gal/person/day (permanent & temporary)	1.46 mgd
	9,500 @ 15 gal/person/day (day visitors)	0.14 mgd
		1.60 mgd

Figures J, K, L, and M represent the best estimates of the study team with respect to present (mid-1975) and probable future population in the Aspen Metro Study Area (including the Aspen Sanitation District), the Snowmass Study Area and Pitkin County. These projections differentiate between permanent and total peak season population (permanent plus tourist average of 30 busiest days).

It should be noted that the attached figures and discussion of trends were presented at a meeting of the Pitkin County Commissioners in August, 1975. There was general acknowledgement of the validity of the assumptions and projections as they related to present policy. However, there was a highly negative reaction to the prospect of population growth over the next 20 - 30 years resulting from even a five percent annual growth rate. Since this presentation, there has been much discussion, both at the county and city levels, about the possibility of further downzoning; about rationing building permits; about other potential tools to limit both the rate of growth and the ultimate level of that growth in areas other than Snowmass. Here, the County feels that EPA's projection is both reasonable and necessary.

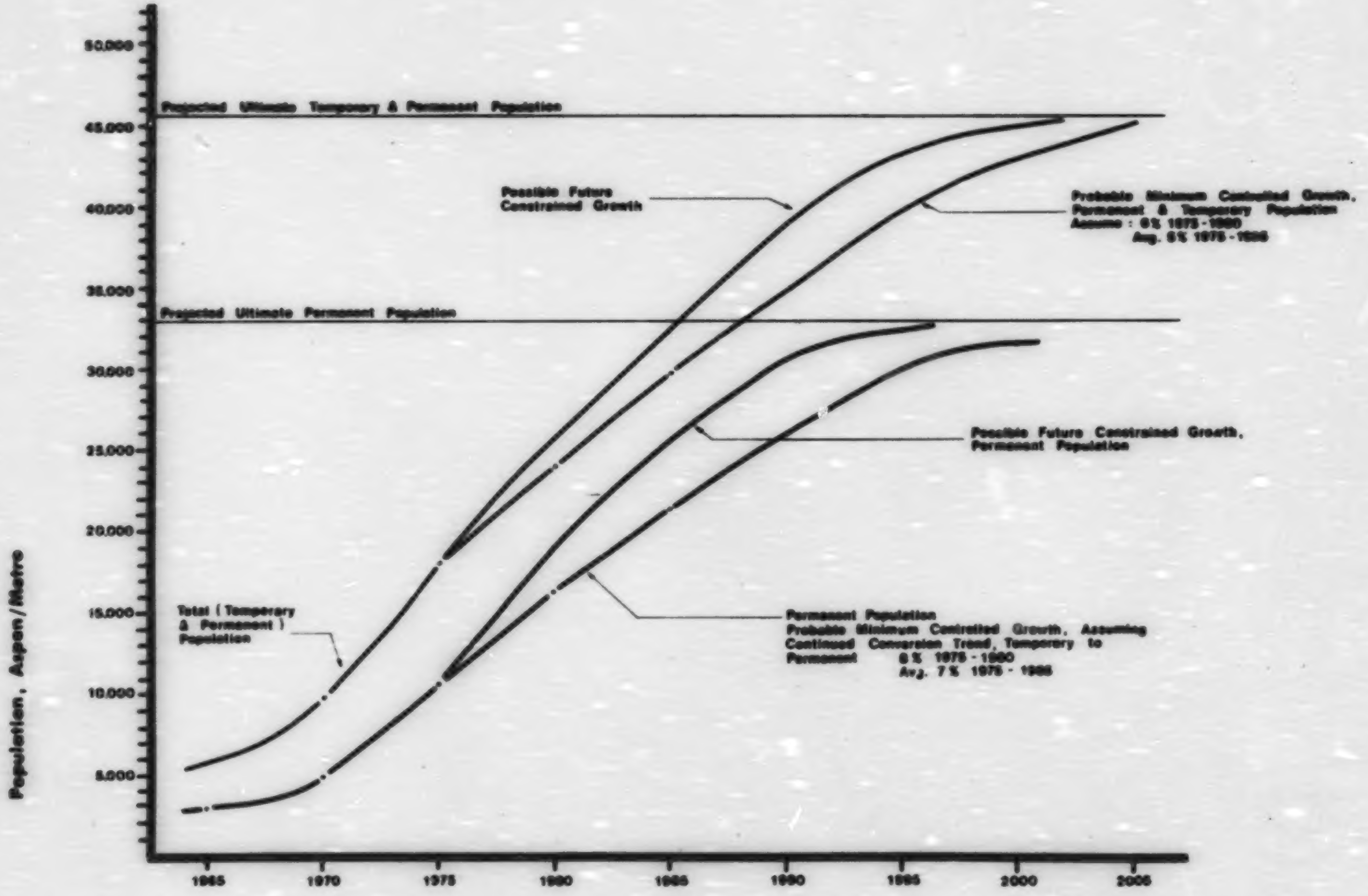
To date, it is not possible to predict with accuracy the result of this renewed intense interest in further limiting the amount or ultimate size of growth. However, it does seem highly unlikely that the exercise of available but heretofore unused growth controls will be so effective as to force a significant percentage (e.g., more than 10 percent) reduction in the forecasted growth rate in any short period of time. Therefore, EPA feels that the projections developed provide a sound basis for wastewater facility planning.

Land Use: Part of Aspen's historic charm has been its Victorian mining camp architecture, and it is perhaps significant that Aspen's rebirth dated from the post-World War II period with Walter Paepke giving paint to residents to restore these houses. Later, in 1963, the first condominium in Colorado was built near Aspen Mountain, the forerunner of a trend that replaced the individual mountain cabin with the lifestyle of urban row houses.

Aspen has endured its share of A-frames, pseudo-Swiss chalets, and condominium complexes -- each in turn adding to the density as well as the

---

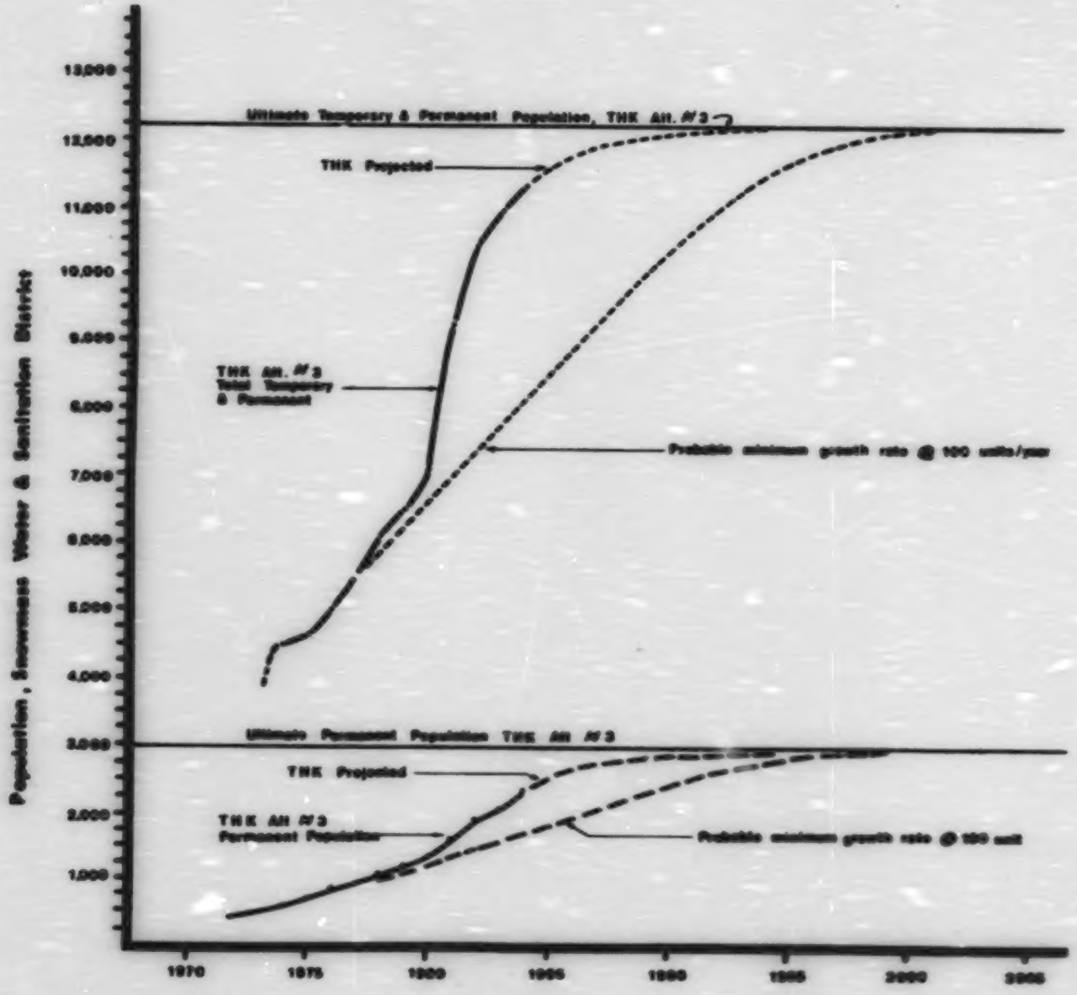
*Snowmass flow includes I&I @ 0.15 mgd.



POPULATION PROJECTIONS, ASPEN/METRO SANITATION DISTRICT STUDY AREA

Figure J

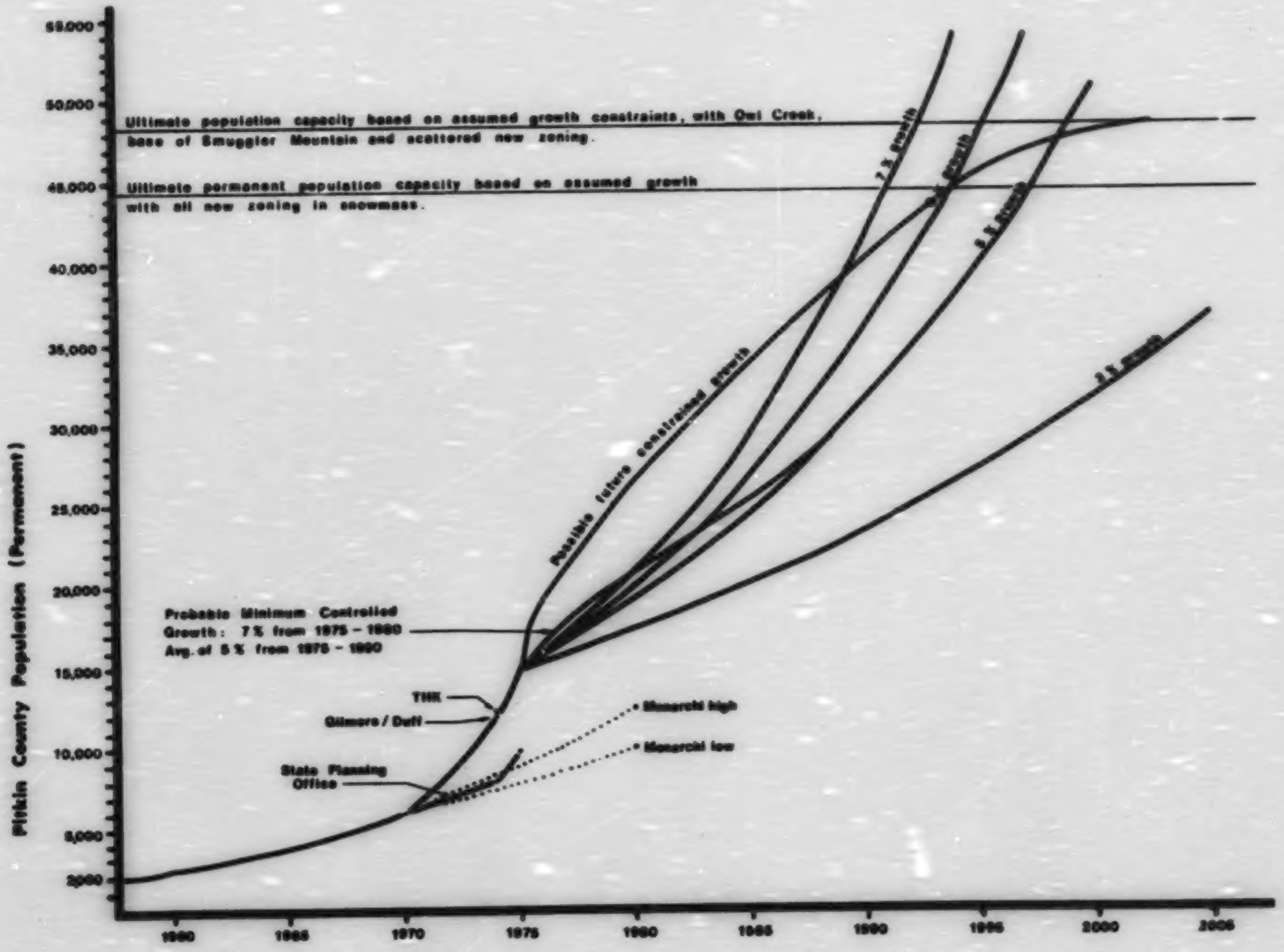
U.S. GOVERNMENT PRINTING OFFICE: [illegible]



POPULATION PROJECTIONS, SNOWMASS WATER & SANITATION DISTRICT STUDY AREA

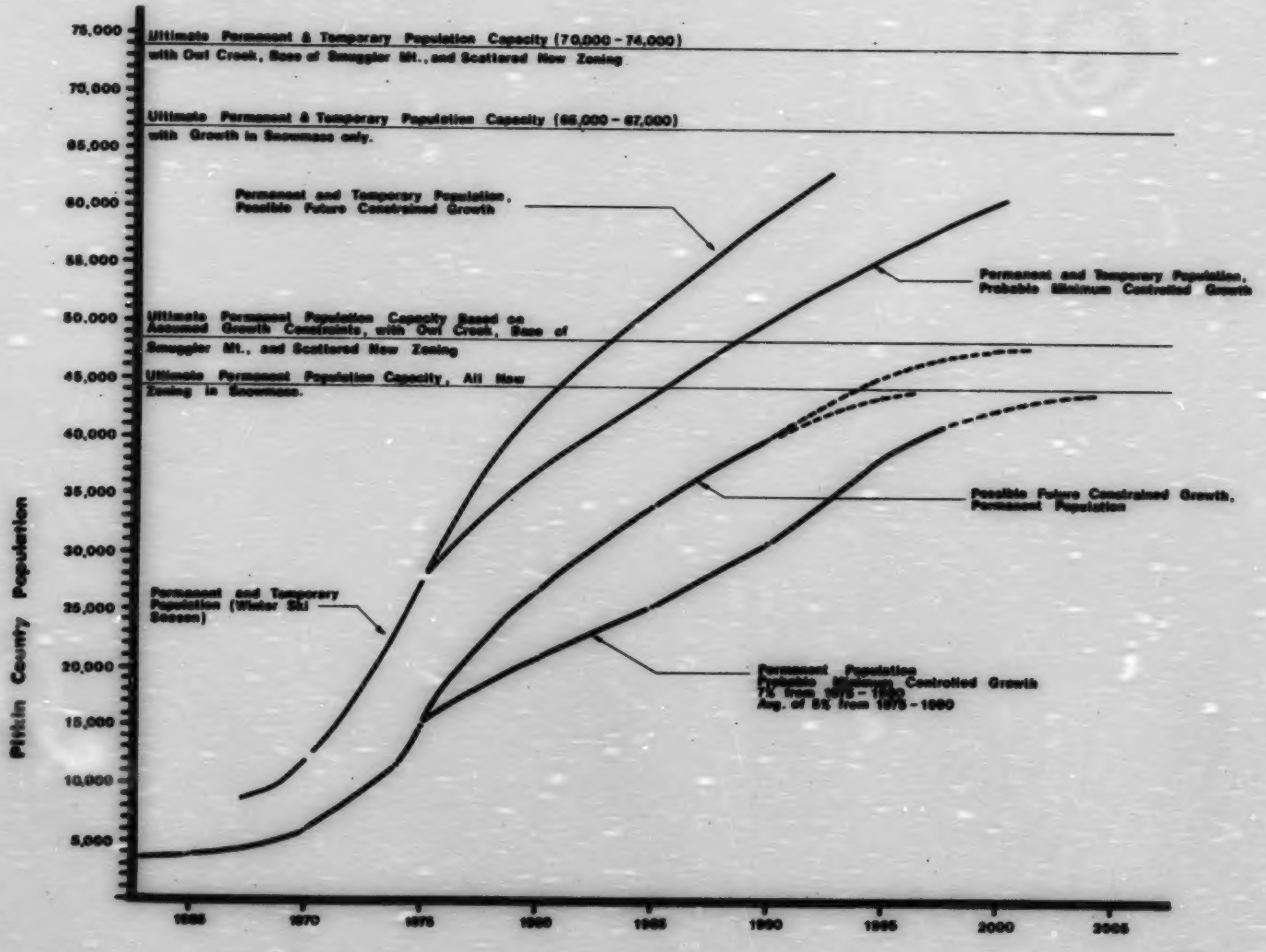
Figure K

U.S. GOVERNMENT PRINTING OFFICE: [illegible]



PROJECTED GROWTH FOR PITKIN COUNTY

Figure L



POPULATION PROJECTIONS FOR PITKIN COUNTY

Figure M

variety of architectural style. As growth pressure in recent years contested with zoning constraints, a trend is evident to build to the maximum density permitted. Fritz Benedict, who has lived and built in Aspen for the past thirty years, describes the transition:

> During the early 1950s when Trafton Bean did the original Aspen zoning plan, land was so cheap that no one bothered to maximize their development. Motels were built with one story and only eight or nine bedrooms per acre in those days, so no one was concerned over the heavy zoning. It was inconceivable that anyone would build twenty-nine units per acre. But this changed and developers sharpened their pencils and built lot line to lot line. Suddenly people began realizing there could be 250,000 people between here and Basalt.

Benedict feels that "growth is here to stay. People wish to maintain historic qualities and to keep a small town atmosphere."

Study Map 2 indicates existing land use in the study area. It also illustrates proposed development in the area and is color coded as to probability of development.

As the map indicates, land use in the study area is primarily residential. There is no heavy industry in Pitkin County and light industry is limited to the vicinity of Smuggler Mountain and the Woody Creek area. Commercial land use is primarily in the Aspen city center, in the airport commercial district and West Village of Snowmass. Most commercial activity in the Snowmass area, however, consists of small shops designed to meet the needs of transient residents (ski shops, boutiques, restaurants) rather than services provided for more permanent residents. The focus of commercial activity for residents of Snowmass still remains in the City of Aspen.

The residential use of the study area is divided between two different types of housing: single family and multiple family, condominium dwelling units. The older single family units are primarily in west Aspen, while newer single family units have been constructed on Red Mountain, at Starwood and at Aspen Meadows. The character of the newer part of Aspen, on the east side of town, and of Snowmass is primarily condominium, cluster, multiple family development.

As the maps indicate, there is a substantial amount of land still in open space; however, given the current political climate in Pitkin County, it seems unlikely that despite outside pressures any major portion of this land will be shifted into alternative uses. Study Map 2 gives probabilities of raw land parcel development. It should be noted that those developments which the study team considers most probable are those which are away from the transportation corridors.

The majority of Pitkin County residents prefer that any development which does occur should be back on the mountainsides, rather than close to the main access roads. The local public officials are committed to resisting the

Preceding page blank

development of an urban corridor along State Highway 82. These goals seem more likely to be met as the Pitkin County planners have recently completed a "Land Use Code" which combines zoning, subdivision and supplementary regulations into a single review procedure. This document is intended to reflect and facilitate the implementation of the goals and objectives of the county, as well as prevent any further proliferation of overlapping land use regulations. The adoption of this code allows both prospective land developers and county officials to review each proposed development in relation to its conformance with existing land use plans and county growth goals.

As with the population projections, the attached land use maps were presented to the Pitkin County Commissioners, the Snowmass Caucus, city and county employees, and numerous residents of the area. All persons interviewed concurred with study team land development probabilities.

Financial Conditions of the Districts

The Aspen and Snowmass wastewater management planning areas contain two sanitation districts and one combined water and sanitation district, each a quasi-municipal special district formed under Title 32 of Colorado Revised Statutes. These are the Aspen Sanitation District, the Aspen Metropolitan Sanitation District, and the Snowmass Water and Sanitation District. The Aspen and Aspen Metropolitan Districts share a sewage treatment facility on Mill Street in downtown Aspen, and the Aspen Metro District has a second treatment facility downstream from Aspen on the Roaring Fork River. The Snowmass District's sewage treatment facilities are on Brush Creek, a tributary of the Roaring Fork. None of the sewage districts in the planning area can meet future effective Colorado discharge standards for ammonia or residual chlorine with their present facilities. On the basis of the population projections prepared for this EIS, Wright-McLaughlin has determined that additional processes and eventual expansion can be done at existing sites. This would maximize use of existing facilities and eliminate need for a new regional plant in the future.

Upgrading and expansion of the sewage treatment facilities will cause a significant financial expense for the three districts, even with the federal assuming 75 percent of the total capital cost under the provisions of Section 201 of the Water Pollution Control Act of 1972.

Aspen Sanitation District: This district is in sound financial condition. During 1975, the District realized about $200,000 from taxes and service charges. After expenses, $51,217 was added to retained earnings, bringing this account to $417,726. The District has $1,112,943 in assets and has reduced its long-term debt to $272,000 which is scheduled to be retired by 1984 at the rate of approximately $25,000 each year. The Aspen Sanitation District's property tax history over the last three years reflects its stability:

Year	Valuation	Mill Levy	Nominal Tax Revenue
1973	$19,424,550	4.00	$77,698
1974	20,216,650	4.00	80,867
1975	20,658,420	4.00	82,634

The Aspen Metropolitan Sanitation District: Organized in 1966, this District had $1,245,000 of general obligations bonds outstanding at the end of 1975, plus part of a refunded series backed by funds in escrow. During 1975 the District realized $313,805 in operating revenues, primarily service charges and property taxes, and used its excess revenues of $68,570 to reduce its operating deficit, built up in previous years, to $133,440. After adjusting for the refunded bonds and escrowed securities, the District has about $375,000 in current assets, $185,000 in current liabilities and $3,700,000 in total assets. The bonded debt is scheduled to be retired by 1989 and has an annual payment schedule ranging from $70,000 in 1976 to $125,000 in 1988. The operating revenue surplus in 1975, after two years of small deficits, and the substantial growth in property valuation (see below), indicate that the District is in relatively sound condition. Debt service appears to be a relatively easy burden to the District at an 8 mill levy.

The Aspen Metro District's property tax history over the last three years is as follows:

Year	Valuation	Mill Levy	Nominal Tax Revenue
1973	$13,928,000	6.00	$83,568
1974	16,349,000	8.00	130,800
1975	18,183,640	8.00	145,469

Snowmass Water and Sanitation District: This District has suffered from an oppressive debt burden assumed during its optimistic beginning in 1966, compounded by a substantial loss incurred from the wrongful misappropriation of funds by a former District Manager. Nevertheless, the District appears to have taken the management actions necessary to maintain financial solvency through increases in property taxes and service charges, and management economies. The organization and facility costs of the District were covered through issuance of some $4 million in bonded debt with debt payments scheduled to balloon to correspond to an optimistic growth projection. Slower than projected growth, combined with the misappropriation of funds (which resulted in a judgment of $200,000 against the former District Manager, of which nearly 75 percent remains uncollected and uncertain) left the District in serious financial circumstances. The District issued a refunding series of bonds in 1971 and again in 1972, and increased its fees and taxes. The monthly service charges have increased as follows:

Size of Lot	1966	1972	1974
Under 1/2 acre	$34.50	$51.00	$61.20
1/2 to 1 acre	37.50	55.50	66.60
1 to 3 acres	42.00	63.00	75.60
Over 3 acres	51.00	75.00	90.00

In addition, the District instituted an availability charge, amounting to two-thirds of the monthly service charge, for undeveloped lots in the District. Proceeds from the availability charge are used exclusively for payments on bonded debt.

The Snowmass property tax levy, originally 5 mills, was raised to 8 mills in 1973 and to 18-1/2 mills in 1974. The trend in assessed valuation and tax income is as follows:

Year	Valuation	Mill Levy	Nominal Tax Revenue
1973	$12,592,240	8.00	$100,738
1974	14,293,730	18.50	264,434
1975	14,916,480	16.76	250,000

The District incurred a net loss of $53,526 in 1974, an improvement over the $143,549 loss in 1973. The increased tax levy in 1975 was a factor in the District's net profit of about $192,000 in 1975, according to as yet unaudited financial statements. This reverse of trend indicates a significant recovery of financial stability by the District.

The current bonded debt, less refunded issues, was $4,120,000 on December 31, 1974. Current annual payments, amounting to $165,000 during 1974, are scheduled to reach a peak of $514,757 in 1982. The final bonds will be retired in 1991.

Overall, the condition of the Snowmass Water and Sanitation District appears delicate but stable. A recovery in growth and development of residential properties in Snowmass will significantly aid the District's financial position.

History, Archaeology, and Aesthetics

The Roaring Fork Valley abounds with historic relics from the Ute Indians and the height of the mining era (1880-1900). The Utes left the area in 1880 after an agreement with the federal government which placed them on a reservation in Southwest Colorado. The mining boom faded around 1900 leaving a quiet mountain valley until after World War II when skiing and tourism re-stimulated the local economy. Members of the Tenth Mountain Division, who trained near Aspen during World War II, returned after the war to live and develop Aspen into a resort now internationally known.

The proposed sewage treatment alternatives utilize present plant sites. These sites do not adversely impact any known localities of historical value. Similarly, proposed new facilities do not create any foreseen problems. A more complete discussion of the Aspen/Snowmass area history is presented in "Preliminary Environmental Impact Analysis of the Proposed Pitkin County Light Rain Transit System" (Weiner & Associates, 1976).

Archaeology: According to the state Archaeologist there are no archaeological sites within the study area. However, the state's files are incomplete, as noted by Hannah Huse, survey archaeologist, in a letter of June 25, 1975 (Appendix C):

> At this time our records are not comprehensive and usually not representative of the variety of prehistoric materials present in the area.

Since construction will be limited to existing sites, no archaeological impacts are anticipated Nevertheless, if construction activities uncover items of possible archaeological value, construction should be halted until they can be evaluated by an expert authority.

Aesthetics: This topic involves a subjective judgment and cannot be quantitatively analyzed. However, there is little disagreement over the natural beauty of the Aspen area, which enjoys an international reputation as a scenic and sophisticated recreation spot.

Because of its subjective nature, any determination of the aesthetic impact of sewage facilities should be left to local residents. Historically, sewer systems have been kept away from populated areas due to noise and odor potential as well as the visual intrusion of concrete, pipes and steel. Steps that can be taken to reduce the eyesore potential include placement of trees, bushes and berms around the facilities, and paint or other design work that would allow the facilities to blend in with the natural surroundings as much as possible.

Public Recreation

Summer activities include hiking, raft trips, fishing, bicycling, tennis, kayaking, mountaineering and camping which, in addition to skiing, have made the Aspen area an ideal place to experience outdoor recreation. Downhill skiing is provided at four areas, accommodating as many as 21,000 skiers/day. If developed to its potential, 54,000 skiers could be accommodated on new and existing slopes along a 12-mile stretch of the Elk Mountains (*Aspen Times*, December 4, 1975). The 200 runs and 300 miles of existing skiing range from novice-oriented runs at Buttermilk to the intermediate/advanced trails at Snowmass and Highlands. Aspen Mountain provides the challenge for advanced and expert skiers. One run down Aspen Mountain's International-Silverqueen or Little Percy will graphically present the most challenging ski runs in the state.

Both Aspen Mountain and Aspen Highlands host international skiing competitions including the Roch Cup and NASTAR races. Snowmass is the largest ski area offering the greatest variety to intermediate skiers.

The four ski mountains are leased from the U.S. Forest Service and operated by two organizations: The Aspen Skiing Corporation and the Aspen Highlands Skiing Corporation.

An extensive system of hiking trails, benefiting both Aspen and Snowmass, is being developed. This trail system has been planned as a natural extension of the street system of the City of Aspen, to encourage hiking, bicycling and nordic skiing. In planning and financing, and obtaining land for trails, the hiking trails provide a great potential for cooperation among the many governmental entities that service the study area (federal, state, county, city and district).

Besides leasing National Forest land for ski areas, the U.S. Forest Service provides many organized campgrounds, picnic areas, hiking and horseback trails in the Aspen/Snowmass vicinity. The Maroon Lake Campground is now so popular that tourist access must be carefully controlled; the popularity of the area places great occupancy pressure on the camping and picnic facilities despite their annual enlargement.

In Snowmass, designed as a destination resort primarily for vacationers, the Snowmass Corporation has constructed an 18-hole golf course, country club, stables and horse trails plus a rodeo grounds, numerous tennis courts and 17 swimming pools. The major facilities are operated by the Snowmass Corporation, while the pools are operated by the Snowmass Resort Association.

Transportation

Pitkin County, particularly the Roaring Fork Valley, has been extensively studied for all modes of transportation. Foot trails, bike trails, free-bus systems, vehicle by-pass corridors, light rail transit, one-way streets, interceptor parking lots, time-limited parking zones, auto-free malls, and even horse drawn sleighs are among the many concepts which have been proposed or implemented at one time or another to solve Aspen's chronic traffic problems. Yet, problems of congestion and noise persist during the winter and summer months even though plausible recommendations have been made in the Aspen General Plan (1966), the Regional Transportation Plan (Voorhees, 1973), and the Pitkin County Light Rail Transit System (Ross, 1974). These plans call for long-range programs which discourage reliance on motor vehicles which are seen as the principal culprit in the county's transportation problem.

Existing roadways are or soon will be overloaded (Halprin 1975). Growth will only serve to worsen this situation. Although seasonal tourists aggravate periodic congestion, the local element makes heavy use of near in-town traffic generators such as City Market, the Main Post Office, City and County Office Buildings, as well as Colorado 82 during rush hours when a large number of down-valley residents commute to Aspen and Snowmass to work.

Recreation areas, particularly during the summer, are dominated by tourist traffic. Heavy traffic volumes in June, July and August, have put a serious strain on Forest Service facilities along Maroon Creek and the Upper Roaring Fork valley. Tourists drive endlessly seeing the sights and looking for John Denver's house.

Public Transportation: A limited access, by-pass parkway may be warranted between Aspen and Sardy Field, for safety if for no other reason. But enlarged road systems provide short-term solutions at best. They do not in themselves generate more tourism and growth related impacts; however they do facilitate and perpetuate these conditions.

In the mid-1960s, before existance of the Snowmass Resort, developers envisioned some sort of a rail system linking this planned satellite community with the Aspen core. The Pitkin County Commissioners renewed this concept in 1974 with the goal of providing an alternative to the automobile. A strictly bus system lacked the appeal of a fixed rail mode which would allow passengers to experience transit divorced from the noise and stop and start routine of conventional roadways. Extensive studies have occured over the last two years in hopes of making the light rail a reality.

Recently, County citizenry have become quite concerned about project funding. The local share of costs, assuming availability of federal matching funds, has become a heated issue resulting in petitions against the light rail proposal. Whether a light rail or continued bus system serves the Aspen-Snowmass area remains to be seen. There is however, almost unanimous agreement that public transit is a must and that automobile disincentives must be employed.

Noise

Noise is often referred to as the ultimate environmental insult. In the Aspen/Snowmass area motor vehicles are responsible for sound levels which often exceed Aspen's city ordinances.* Levels of sound are usually measured in decibels (dB). Whispers might register as 20 to 30 dB on a sound-level meter, while a reading taken near a working jackhammer could be 115 dB or more. Because decibels are based on logarithms, every increase of 6 dB indicates a twofold increase, and 10 dB a threefold increase, in the sound level. At about 120 dB, discomfort to the ears begins. At about 140 dB, pain begins. Hearing damage depends not only on the sound level but also on the duration of exposure to the sound.

Noise measurements have been taken by local officials with additional levels measured as part of this Environmental Impact Statement. These measurements show an incremental increase of approximately 30 dB(A) attributable to motor vehicles in rural parts of the Aspen area. An increase of 7-11 dB(A) applies in the downtown area where automobiles have not been displaced by malls. A general Radio Type 2 (model GR1565-B) instrument was used for the measurements summarized in Table II-4.

TABLE II-4

Location	Measurement dB(A)-Averages
Original at Durant Streets	65
Galena at Hyman	73
Galena at Hopkins	70
Mill at Main	73-77
Cooper at Spring	56-67
Hyman at Spring	63-70
Colo. 82 at Mountain Valley	<40-71
Colo. 82 at Airport	69-76

Measurements taken along the perimeter of the existing sewage treatment plants showed that noise levels varied from 54 to 64 dB(A). Higher levels prevailed closer to the banks of the Roaring Fork. Levels at the three plants are primarily affected by blower motors and related equipment operation and do not adversely effect nearby residents.

Solid Waste

Citizens in the Aspen area have instituted a program to separate and reclaim resources. This admirable effort stands a good chance of succeeding as long as public interest prevails. A designated land fill site is located down valley below Woody Creek and has a reasonable but limited future capacity. Sludge disposal is currently accomplished at a site south and along a bench of the Roaring Fork. This site and its future use is discussed in detail in the point and nonpoint portion of the Water Quality Chapter.

---

*Aspen City Ordinance, Chapter 16, Section 1-4 regulates idling vehicles, requires mufflers and prescribes an 80 dB limit within the City (A scale at 25 ft from the source).

Other Federal Projects

Other federally-funded or related projects that could impact the study area include highway improvements, airport expansion, water diversion, mass transit support and ski expansion. Specifically, the projects are:

- Improvement of State Highway 82 between Carbondale and Aspen. The improvements would be carried out by the Colorado State Department of Highways (CSDH), with funding assistance from the federal government. However, according to a CSDH spokesman, no construction will begin until local government has decided what it wants in the way of auto disincentives, public transportation and other growth controls that may related to highway use.

- Expansion and development of the Aspen-Pitkin County Airport (Sardy Field), with the Department of Transportation, Federal Aviation Administration being the responsible federal agency. Long-term plans include installation of aviation lighting and navigation aids, hangar construction, and expansion of general aviation and air carrier aprons.

- The Fryingpan/Arkansas water diversion project, a Bureau of Reclamation program to supply western slope water for irrigation use in the Arkansas River Valley on the eastern slope. The project, a series of dams and diversions, is mostly completed, and has affected flow in the Roaring Fork. Hunter Creek diversion is also authorized, and if built could periodically reduce flow in the Roaring Fork. The magnitude of this potential impact cannot be determined at this time due to the absence of specific diversion plans.

- A possible grant from the Urban Mass Transportation Administration (UMTA) of the Department of Transportation to build a light rail transit system. The system would connect the town of Aspen with Snowmass, ski areas, and other important stops in-between.

- Two new ski areas plus expansion of existing areas. The two new places would be Little Annie, with potential for 3,000+ skiers per day (rough estimate) according to U.S. Forest Service officials, and Owl Creek, between Buttermilk and Snowmass, with a capacity in the neighborhood of 500 skiers per day according to the Forest Service. Neither has yet received a federal permit, and issuance would depend on local desires, according to the Forest Service. Existing areas with potential for some expansion are Aspen Highlands and Buttermilk, while Snowmass has potential for major expansion.

- The county has also expressed a desire to limit auto traffic to Maroon Bells as well as through Independence Pass. However, at this juncture no federal involvement has been formulated.

III.

DESCRIPTION OF PROPOSED ALTERNATIVES

The Regional 201 Facilities Planning effort for Aspen and Snowmass has principally involved the Districts and Wright-McLaughlin Engineers, with additional input from the EPA, the Colorado Water Quality Control Commission, and Weiner and Associates. This interchange has resulted in the development of secondary and tertiary treatment alternatives for Aspen and Snowmass, and included an evaluation of the "no action" alternative for both of them. All of the alternatives involve various combinations of in-plant treatment and land treatment; their details are discussed in the text that follows.

ASPEN ALTERNATIVES

The population projections discussed in Chapter II allowed Wright-McLaughlin to conclude that the existing Aspen Metro plant site has sufficient space to allow for short-term and long-term treatment requirements. Therefore, no new plant sites or interceptor sewers are proposed. The alternatives deal with in-plant treatment options, the 1977 retirement of the ASD plant, and the potential for tertiary treatment via land application. Sludge treatment alternatives are also proposed, all of which involve use of the existing disposal site. The proposed alternatives for Aspen are summarized in Table III-1.

Since the Aspen Metro plant is a modern activated sludge secondary plant in compliance with current standards, it is both logical and cost-effective to propose the enlargement of this facility as needed. In addition, long-term capacity can be accomodated in the space available at the present site. Therefore, the only decision to be made, as far as secondary treatment is concerned, is whether to close the older ASD plant in town and enlarge at Metro; or continue ASD plant operations for the remainder of its useful life (1990). Alternatives I and II represent this choice, however both will require advanced treatment for ammonia and residual chlorine. Wright-McLaughlin determined early in the Step 1 effort that advanced treatment was not cost-effective at the ASD plant. Therefore, Alternative I is the only secondary option which, in combination with advanced facilities, will comply cost-effectively with future discharge limitations (Chapter IV).

Alternative II proposed without ASD advanced treatment, would not comply with standards and could only be considered if the State of Colorado would grant a discharge variance for the useful life of this plant; considered unacceptable to EPA. The Facilities Plan

Preceding page blank

TABLE III-1

ASPEN TREATMENT ALTERNATIVES

Secondary Treatment	Advanced Treatment	Sludge Disposal
I. Retire ASD plant in 1977 and enlarge AMSD activated sludge plant in 1977 from 2.0 to 3.0 mgd. Second phase construction will occur in 1990 from 3.0 to 4.0 mdg.	A. Advanced biological at AMSD plant via activated sludge nitrification (1977).	1. Aerobic digester, centrifuge, truck to existing site (see Figure H).
II. Retain ASD plant without 1977 expansion and upgrade present equipment at AMSD plant. Second phase construction to combine capacity of 4.0 mgd--date unspecified.	B. Advanced biological at AMSD plant via rotating bio-discs for nitrification (1977).	2. Gravity thickener, aerobic digester, truck or pipe to existing site.
	C. Advanced biological at AMSD plant via trickling filter nitrification (1977).	3. Two stage anaerobic digester, centrifuge, truck to existing site.
	D. Build storage reservoir for winter effluent, land treat during summer via Salvation Ditch-1977. (see Study Map 3).	
	E. Advanced biological at AMSD plant via trickling filter nitrivication-winter, pump summer effluent to Salvation Ditch for land treatment.	
	NOTE: No advanced treatment alternatives are proposed at ASD plant in conjunction with plant retention.	

refers to these alternatives as ST-1 and ST-2 respectively.

Alternative I/A: ABT-Activated Sludge (in-plant)

This alternative would utilize an activated sludge-nitrification ammonia removal process for advanced biological treatment (ABT). This would involve an aerated nitrification basin with tertiary clarification and sludge return. Following tertiary clarification, the treated effluent would flow through an aerated flow leveling pond and then through a mixed media filter for further suspended solids and BOD removal before final disinfection and discharge. Residual chlorine concentrations would be controlled via natural aeration through a designed discharge route (rock channel) to the Roaring Fork. This alternative is identical to Wright-McLaughlin's alternative AT-1.

Alternative I/B: ABT-Bio-Discs (in-plant)

This alternative is identical to alternative A except that advanced biological treatment for ammonia control would be realized via rotating biological discs. All subsequent treatment steps are identical to the previous alternative except clarifiers are not required. Alternative B is identical to Wright-McLaughlin's alternative AT-2.

Alternative I/C: ABT-Trickling Filter (in-plant)

This alternative is identical to alternative B except that ammonia nitrogen removal is realized via an enclosed plastic media trickling filter. All subsequent processes are the same as employed in the previous alternative. Wright-McLaughlin calls this alternative AT-4.

Alternative I/D: Land Treatment

This alternative would employ a land treatment irrigation scheme for additional ammonia nitrogen, suspended solids, and BOD removals. In this alternative the secondary treated waste would be disinfected and then pumped to a large storage reservoir, designed to accomodate winter flows when irrigation is not possible. The site of this reservoir is shown in Study Map 3, located off of the Roaring Fork about 1,000 feet upstream from the sewage plant. Its total capacity would equal 988 acre-feet. The water would be pumped from this reservoir to the Salvation Ditch for agricultural irrigation. The existing distribution system would be maintained, which employs flooding, contour ditches and spray-irrigation techniques. Sufficient quantities of land would be involved so that standard hay cutting operations would be maintained.

Alternative I/E: Winter ABT (in-plant) and Summertime Land Treatment

This alternative uses advanced biological treatment (ABT) via a trickling filter during winter months. Summer effluent is used for land treatment through use of the nearby Salvation Ditch. This approach eliminates the cost prohibitative storage reservoir of alternative I/D but still uses the nutrient value of the effluent. Winter treatment as well as summertime backup is provided by an in-plant system similar to Alternative C.

Sludge Treatment

The proposed alternatives for sludge disposal offer three technical varieties of in-plant processes including (1) aerobic digester and centrifuge, (2) gravity thickener and aerobic digester, and (3) two stage aerobic digester and centrifuge. The existing disposal site shown in Figure N would continue to serve the AMSD plant. Sludge is delivered to the site either by trucking or by pipeline without in-plant centrifuging.

The current sludge disposal site contains about 50 acres of relatively flat, rocky ground on the W/J Ranch, approximately two miles northwest of the Aspen Metro plant. The current plan for ultimate disposal calls for the stabilized sludge to be deposited in trenches, mixed with soil, and then covered. Vegetation such as crested wheat grass would be planted between the trenches and the nutrient value of the sludge would be utilized by the vegetation (Wright-McLaughlin Engineers, December 1975). Wright-McLaughlin Engineers calls this overall approach alternative STD-1.

SNOWMASS ALTERNATIVES

The range of alternatives originally proposed have been evaluated to reduce to three basic approaches for advanced waste treatment (see Table III- 2). Only one recommendation has been presented for secondary treatment and this action would be compatible with all of the proposed advanced waste treatment schemes. The plant would utilize the existing site and collection system with improvements proposed for the collection system.

Alternative III: Secondary Treatment Expansion

The secondary treatment proposal for the Snowmass plant is to expand the existing facility to handle a maximum flow of 1.6 mgd. Note that this represents a doubling of treatment plant capacity. (The original master plan for the Snowmass plant called for an ultimate capacity of 3.2 mgd. However, from the population projection developed by Weiner & Associates (page 50), Wright-McLaughlin determined that 1.8 mgd would be the maximum needed.) The major items associated with this expansion include the following:

- o Two new secondary clarifiers
- o Two new aerobic digesters
- o One sludge centrifuge
- o Replacement of pond aeration system
- o Expansion of chlorine contact chamber
- o Rock channel for dechlorination.

The secondary treatment process would continue to utilize the activated sludge, biological process with secondary clarification and sludge return. After secondary clarification, the flow would be directed either to an in-plant advanced treatment unit or to the aerated polishing pond prior to land application. Full disinfection via chlorination would be provided prior to land application or discharge to Brush Creek. The waste activated sludge from the secondary biological process would be aerobically digested, gravity thickened, and dewatered by centrifugation. The sludge lake, expected to average 16 to 20 percent solids, would be utilized as stabilized fill in the Snowmass vicinity or hauled to the Aspen sludge disposal site. The plan for ultimate disposal at the Aspen Metro site (Sludge Alternative 4) calls for the stabilized sludge to be deposited in trenches, mixed with soil and covered. Vegetation would be planted between the covered trenches and the nutrient value of the sludge would be utilized via plant uptake. The proposed application rate

TABLE III-2

SNOWMASS TREATMENT ALTERNATIVES

Secondary Treatment	Advanced Treatment	Sludge Disposal
III. Enlarge existing activated sludge secondary facilities from 0.8 to 1.6 mgd in 1977.	F. Advanced biological at Snowmass plant via activated sludge nitrification (1977)	4. Aerobic digester, thickener, centrifuge and truck to Metro site
IV. Enlarge existing activated sludge secondary facilities from 0.8 to 1.2 mgd in 1977. Additional expansion from 1.2 to 1.6 mgd in 1981.	G. Advanced biological at Snowmass plant via rotating bio-discs for nitrification (1977).	
	H. Advanced biological at Snowmass plant via trickling filter nitrification (1977)	
	I. Build storage reservoir for winter effluent, summertime land treatment (1977)	
	J. Winter ABT via trickling filter, summertime land treatment on golf course.	

is 15 dry tons of sludge per acre per year.

Alternative III/F: ABT-Activated Sludge (in-plant)

This alternative would utilize an activated sludge ammonia removal process, involving an aerated nitrification basin with tertiary clarification and sludge return. Following tertiary clarification, the treated effluent would be discharged to the flow equalization pond for temporary storage and polishing. Finally, the flow would be directed through mixed-media filters for further suspended solids and BOD removal, prior to chlorination and discharge. Wright-McLaughlin refer to this as Sub-Alternative 2A.

Alternative III/G: ABT-Trickling Filter (in-plant)

Referred to in the Facilities Plan as Sub-alternative 2B, this would use a plastic media trickling filter for ammonia removal, in lieu of the activated sludge process described above. The effluent from the trickling filter would be further treated by breakpoint chlorination, to achieve the required ammonia removal efficiency. Positive dechlorination would be accomplished via sulfur dioxide (sulfite) addition. The effluent would then be directed back to the polishing pond, where mixed media filtration would occur prior to discharge.

Alternative III/H: ABT-Bio-Discs (in-plant)

This alternative is identical to the III/F above except that rotating biological discs would be utilized, in lieu of the activated sludge process for ammonia removal. All other features are identical to the III/F alternative and are not repeated here (Wright-McLaughlin, 2C).

Alternative III/I: Land Treatment

This alternative would consist of land application systems in the Owl Creek basin and on the Snowmass golf course. During seven winter months the secondary plant effluent would be pumped to the Owl Creek basin for winter storage and subsequent summer irrigation. The winter storage would be placed in the reservoir shown in Study Map 3, which would have a winter storage capacity of 600 acre-feet. The water would then be distributed to an estimated 195 acres of meadow and pasture areas via the existing Willow, Owl, and McPherson Ditches. Irrigation would be by flooding and the proposed application rate is of the order of three acre-feet per acre per year. During the normal summer irrigation months, the Snowmass golf course would be irrigated with plant effluent.

Alternative III/J: Winter ABT, Summertime Land Treatment

This alternative is somewhat of a hybrid of the other sub-alternatives. An in-plant advanced system would be utilized, consisting of either trickling filter or bio-discs during the winter months. During the summer irrigation season, the normal plant flows would be used for the irrigation of the Snowmass golf course.

The final alternative is the no-action approach that would allow for the continued operation of the existing three plants as is. No additions of these facilities would occur to increase capacity or to reduce output of ammonia, residual chlorine, suspended solids and biological oxygen demand. However, maintenance on the existing equipment or interceptors could occur and would be advisable.

Alternative IV: Secondary Treatment Expansion in Phases

The existing plant is designed for modular expansion in increments of 0.4 mgd. This alternative would increase the present secondary facilities from 0.8 to 1.2 mgd in 1977. This expansion together with sewer line inflow and infiltration repairs, will provide adequate capacity until 1981 when additional expansion would be required. Advanced treatment Alternatives F through H would also be designed in similar stages where practical.

This alternative was excluded early in the 201 planning process by Wright-McLaughlin (WME). Engineering design and construction in 1977, followed again in 1981 will require a far greater capital investment than would one-time design and construction in 1977. That is, WME has concluded that expansion from 0.8 to 1.6 mgd in 1977 (Alternative III) is the only cost-effective approach due to the brief four year period between the two phases of construction. This is different than the case for Aspen Metro where second phase construction is not necessary until 1990.

IV.

EVALUATION OF THE ALTERNATIVES

This section sets forth the projected impacts associated with the action alternatives and the one no-action alternative. These alternatives are described in the previous section and are summarized below.

Aspen

Secondary Treatment	- Alternative I	-Activated Sludge, Retire ASD plant (1977)
	- Alternative II	-Activated Sludge, ASD plant
Advanced Treatment (ABT)	- Alternative A	-Activated Sludge
	- Alternative B	-Rotating Bio-Discs
	- Alternative C	-Trickling Filter
	- Alternative D	-Winter storage, summer land treatment
	- Alternative E	-Winter ABT, summer land treatment
Sludge Disposal	- Alternative 1	-Aerobic digester, centrifuge, truck to site
	- Alternative 2	-Gravity thickener, and truck or pipe to site
	- Alternative 3	-Two-state anaerobic digester, centrifuge and truck to site

Snowmass

Secondary Treatment	- Alternative III	-Activated Sludge
Advanced Treatment	- Alternative F	-Activated sludge
	- Alternative G	-Rotating bio-discs
	- Alternative H	-Trickling filter

	- Alternative I	-Winter storage, summer land treatment
	- Alternative J	-Winter ABT, summer land treatment
Sludge Disposal	- Alternative 4	-Aerobic digester, thickner, centrifuge and truck to Metro site

Aspen and Snowmass

No-action Alternative — Continued use of existing facilities as is.

The environmental impacts of these alternatives are discussed in the text that follows under the headings of water quality, geology, soils, biology, climatology and air quality, land use and costs.

WATER QUALITY

The impacts on the area's water quality can be divided into those on surface waters and groundwaters. If the in-plant alternatives are implemented and the discharge regulations are adhered to, then the impacts on surface waters should be positive. However, the overall quality of the Roaring Fork River could still deteriorate if urban and agricultural runoff are not checked. If the no-action alternative is chosen, then the impact on the Roaring Fork would be negative, since the increased influent loads in the future would exceed the capacity of existing plants to adequately treat them. If a land treatment alternative is chosen, then the groundwaters could be impacted. Whether this impact is negative or positive depends on the quality of the wastewater and the application rate. The text that follows discusses all these contingencies in greater detail; the topics are: in-plant processes, land treatment processes and sludge treatment processes.

In-plant Processes

The operational goal of the in-plant alternatives is the discharge of effluents that meet the 1983 standards, as outlined in Chapter I. Assuming these standards are met or exceeded, the impact on the existing aquatic ecosystems would be positive. However, if some of the standards are not adhered to, then ecosystem or agricultural deterioration could occur. All of these factors are discussed in the following section under the headings of engineering and aquatic considerations.

Engineering Considerations: The decision facing the sanitation districts during their alternative evaluations will involve considerations of process treatment efficiency, process reliability, capital costs, operation and maintenance costs, and operator control requirements. The purpose of this discussion is to identify the positive and negative aspects of these considerations for the proposed treatment processes.

The preferred alternative for secondary treatment at Aspen would involve abandonment of the ASD plant in 1977 and increasing AMSD's capacity from 2.0 mgd to 3.0 mgd. The main process for accomplishing this would be activated sludge, which is currently in use and providing an excellent level of treatment. Three sub-alternatives have been proposed for the expansion. The first one (Wright-McLaughlin's ST-1a) maintains the current treatment flow scheme. It is the simplest system proposed and would be an advantage since additional operator training requirements would be minimal. The second sub-alternative (ST-1b) would be identical to the first except primary clarification would also be provided. This addition would require anaerobic digestion to stabilize both primary sludges and waste activated sludges. This digestion process requires a lesser power requirement than the aerobic process; however the anaerobic unit is generally more susceptible to upset conditions and requires greater operator attention. The last sub-alternatives (ST-1C) would utilize pure oxygen for support of the active biomass instead of air. It would provide superior digestion and the lowest potential for odor problems. However, treatment with oxygen is more expensive than treatment with air and would represent an increased operational cost.

The other alternative for Aspen's secondary treatment would retain the ASD plant and upgrade facilities at the AMSD plant. Under this plan the ASD plant would operate with existing facilities. It would not be capable of meeting 1977 standards for residual chlorine or ammonia or the 1983 goals for suspended solids, residual chlorine or ammonia. This course of action is not acceptable to EPA.

The secondary treatment proposed for Snowmass involves doubling the existing facilities to accommodate 1.6 mgd. The reliability of this process is well established and the current facility is providing a generally excellent level of treatment. Replacement of the present polishing pond aeration system is also proposed, which is necessary since the existing system is partially non-functional. Additional chlorination facilities and subsequent dechlorination via a rock channel is also proposed. This proposal for secondary treatment could provide acceptable performance although the ability of rock channels to effectively dechlorinate is seriously questioned by EPA. Before the final facilities plan is approved, this issue must be resolved.

The tertiary treatment proposals for Aspen and Snowmass involve more variability in their designs. The in-plant systems proposed for Aspen consist of activated sludge nitrification unit, a bio-disc rotating filter system and an enclosed synthetic medium trickling filter. Each of these processes would be followed by flow leveling and mixed media filtration which would provide for additional suspended solids and BOD removals. If bio-discs or trickling filter systems are used, a secondary clarification step would not be required; however additional backwashing of the multi-media filters could occur with excess accumulations being re-routed through the secondary treatment system. The activated sludge would require secondary clarification.

The treatment efficiencies documented for all three of the processes are high enough to meet the ammonia discharge levels proposed for a variable discharge permit. Such a permit takes into account the flow rate of receiving waters, plus their temperature and pH. These factors affect the amount of ammonia that can be safely discharged and it varies from month to month (Table IV of Appendix A). If adopted, such a permit would allow the operator to reduce O and M costs by removing only the ammonia necessary to protect aquatic life. However, these gains could be offset slightly by increased operator attention in the winter, when ammonia conversion rates are slower.

The basic tertiary systems proposed for Snowmass are identical to Aspen's except the trickling filter system would employ breakpoint chlorination. This process relies on the addition of chlorine to the wastewater, which combines with ammonia to form chloramines. Further addition of chlorine causes the chloramines to convert to nitrogen gas. An additional approach combines wintertime treatment by bio-discs or trickling filters with summertime land treatment on the Snowmass golf course. This alternative would allow some flow through in-plant equipment during the summer, which would help maintain the bio-systems. If future flows exceed the application limit on the golf course, this in-plant flow could be increased as long as the discharge permit is adhered to.

The proposed design criteria for Snowmass include stringent limitations for the discharge of suspended solids, BOD, ammonia-nitrogen, and residual chlorine. When the secondary level of treatment is combined with filtration it will provide for adequate suspended solids and BOD removals. Disinfection with chlorine should also be adequate to meet coliform standards. The extremely stringent ammonia-nitrogen limitations will not, however, be easily met. All of these nitrification systems are temperature dependent and will be difficult for maintaining during the winter months. If a dual in-plant-land treatment system is chosen, an active bio-mass should be maintained all year; this would facilitate the system change-over during the fall. The rock channels proposed for dechlorination may not achieve the desired treatment and may have to be discarded. Alternative systems are available but they are more costly.

The 1983 ammonia-nitrogen requirements for this plant range from 0.89 to 4.85 mg/ℓ and more generally between 1.0 to 2.5 mg/ℓ. These very stringent requirements represent the lower range of treatment levels that the proposed systems can be expected to attain. It is doubtful whether these systems could consistently produce an effluent that would meet the lowest of these requirements. However, the system combining trickling filters and breakpoint chlorination should provide the highest removal rates, although at the expense of increased operating costs. The land treatment technique would also achieve excellent ammonia removal if properly operated. Therefore, the year-round land treatment system or the trickling filter system with late summer land treatment would represent the best means for attaining full compliance with the present design criteria.

Aquatic Considerations: The known parameters of concern are un-ionized ammonia, residual chlorine, biochemical oxygen demand (BOD) and suspended solids. Ammonia would be controlled by the nitrification processes although residual nitrates would be produced for the effluent. These nitrates would add to existing levels of nitrate-nitrogen, which vary between zero and 1.0 mg/ℓ for the Roaring Fork River and between 0.3 and 4.0 mg/ℓ for Brush Creek. Such levels are not believed to cause algal growths (Whitaker, 1976), nor is it known what concentrations would. EPA is studying this problem and is attempting to modify the algal bottle test to assess nutrient concentrations in streams. When this has been accomplished, tests will be run on Brush Creek and the Roaring Fork River, and safe levels of nitrate and phosphate will be recommended.

Even though the ammonia treatment process produces nitrates, it does provide an improvement for the current river systems. It does this by allowing the conversion of nitrogen compounds to take place in the plant, prior to the discharge of toxic forms, like un-ionized ammonia. Such conversions would occur in the receiving waters anyway, but in that case toxic repercussions could occur for fish and aquatic life. With the conversions occurring in sewage plants, fish and aquatic life are protected. Such protection is desired by the Colorado Division of Wildlife, which wants to maintain the Roaring Fork River and Brush Creek as high-quality trout streams.

Additional loading of nitrates to the streams will occur in the future as a result of increased sewage loading. Such increases will occur gradually, as population increases, and their result could be a gradual increase in stream productivity, which would be positive. To follow such a potential trend, periodic monitoring is recommended especially if algal buildups are perceived by the Colorado Division of Wildlife. Such monitoring is not required by EPA, yet when governmental agencies monitor stream quality in the future, it is recommended that nutrients be included in their analysis.

Chlorine is applied to the wastewater for disinfection purposes and its concentration should be reduced prior to discharge. This reduction is necessary for the protection of fish and aquatic life because of the toxic effects of residual chlorine. EPA is concerned with the proposed design (rock channels) to accomplish this task and will be meeting with the design engineer to work out a solution. Other factors like biochemical oxygen demand and suspended solids could also be harmful, yet they too, are to be markedly reduced. None of these three parameters should pose a threat to aquatic life if the in-plant alternatives are implemented. However, all of them should be monitored in the effluent according to the discharge permits, and in the receiving water at least once a year. Monitoring in the receiving water could be done by Colorado Water Quality Control Division when they analyze effluent quality.

Land Treatment Processes

The land treatment alternatives are being seriously considered for both Aspen and Snowmass due to seasonal low flows in receiving waters and their reduced capability for diluting and assimilating sewage wastes. This condition has occurred in the Roaring Fork River, where it was essentially dry for two miles between the Salvation Ditch inlet and Hunter Creek during early Fall, 1975. If water rights on this river could be exchanged for effluent waters, this situation could be prevented or made less likely. Therefore, EPA supports this alternative as does Pitkin County, assuming that the plan can be implemented in an environmentally-sound fashion.

To implement such a plan, it would require a long-term commitment of land from area ranchers (Study Map 3). However, such a commitment is unlikely due to the potential of irrigated ranchlands for urban development. This development could be initiated at any time in the future so some ranchers might be reluctant to restrict their options regarding future use or sale of their lands, especially if a 20-year commitment is involved. Other ranchers might be skeptical of using the effluent and would prefer a shorter agreement, until its value is more thoroughly established.

The treatment alternatives for Snowmass are restricted by seasonal low flow in the receiving waters of Brush Creek. When drought conditions develop here, the in-plant options may not achieve the desired water quality goals, since flows in Brush Creek would then consist almost entirely of wastewater. Consequently, the land treatment scheme is emphasized. Study Map 3 indicates area within the Brush Creek or Owl Creek basins which is suitable for land treatment in conjunction with storage reservoirs. Here again availability of land for long-term use is unlikely and storage reservoirs are cost prohibitive. Alternative III/J would only require use of the Snowmass golf course. The availability of the golf course for this purpose is assured because of the Snowmass community's interest in aiding the district.

The application of sewage effluent to land is not a new practice. A survey conducted by the American Public Works Association (1972) documents at least 315 municipal systems that use this approach (Sullivan, Cohn, and Baxter, 1973). A second study conducted in the Rocky Mountain-Prairie Region identifies 19 municipal sites that use the land application approach (Dean, 1974). These latter sites occur in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming, where applications are used for irrigation of golf courses, crops, hay and/or pastures. The sites for Colorado are listed in Table IV-1.

Land application approaches are generally classified as irrigation, overland flow, and infiltration-percolation. The approach for Aspen and Snowmass is intended to be irrigation, which would be construed as the controlled discharge of effluent by surface spreading and spraying to support plant growth. The basic environmental assets of this action would be: 1) to remove effluent contaminants by using land as a natural filter; and 2) to beneficially support crop production. The principal constituents to be removed would be ammonia-nitrogen, biochemical oxygen demand and suspended solids.

Land application uses the land and its associated biological systems as a living filter. The resultant purification of the wastewater is both microbiological and physio-chemical in nature and includes chemical precipitation, absorption, adsorption, filtration, plant root uptake and oxidation. Many of the impurities that are entrapped in the soil are eventually used by higher plants as growth components and, in the

TABLE IV-1

LOCATION OF EXISTING LAND TREATMENT SITES IN COLORADO

Site	Effluent Source	Location
Air Force Academy	AFA WWTP	Colorado Springs
Aurora Golf Course	Aurora WWTP	Aurora
Colorado Springs Sites	Colorado Springs WWTP	Colorado Springs
Donala Development	Development	Colorado Springs
East Canon	East Canon Sanit. Dist.	Canon City
Fitzsimons Golf Course	Fitzsimons Hospital	Aurora
Inverness Development	Indust. Development	Arapahoe County
Kuner-Empson Co.	Veg. Process. Plant	Brighton
Lake of the Pines Dev.	Left Hand Sanit. Dist.	Boulder County
Lakewood Golf Course	S. Lakewood Sanit. Dist.	Lakewood
Mechaneer West Golf Course	Fort Carson	Fort Carson
Pueblo West Development	Development	Pueblo
Roxborough Park Development*	Development	Douglas County
Taylor Park C.D.	Forest Service Cent. Disp.	Gunnison N.F.
Timmeron Development	Development	Durango

*Facilities in.

process, the wastewater receives the equivalent to tertiary treatment.

The discussion that follows describes this kind of treatment, under the headings of climate, site and soils, treatment efficiency, nutrient utilization by vegetation, effects of nitrogen on groundwaters, effects of trace elements on groundwater, groundwater recharge, surface water runoff, surface water, storage and public health considerations.

Climate: The climatology of a specific land treatment site affects the length of its growing season, the type of crop production, the kinetics of the breakdown of the applied wastes, and the quantity of wastewater that can be disposed. The climate of Aspen and Snowmass is described in other reports and it is not repeated here; however, its growing season is important to the land treatment alternatives. This season lasts from four to five months and it generally occurs from May to October. The short growing season could necessitate the construction of winter storage facilities if no in-plant structures are built for tertiary treatment. Another climatic factor is the relatively cool summer nights, known to slow the biological breakdown of applied organic wastes. However, this factor should not significantly affect the resultant water quality, as long as application rates do not exceed the recommended rates.

The operation of existing land treatment facilities have been documented for northern climates (Sullivan, R.H., etc., 1973; Malhatra, S.K., et al., 1975; Sanks, R.L., et al., 1976; and Sopper, W.E., et al., 1975). Preliminary research of a land treatment project in Steamboat Springs, Colorado indicated that excellent contaminate removal can be attained if the proper design and management is provided (Wright-McLaughlin, October, 1975). Another project in Rawlings, Wyoming indicated that wastewaters could be successfully used to raise alfalfa (APWA, 1973). This project involved winter storage and summertime irrigation, similar to the two alternatives being proposed for Aspen and Snowmass.

Site and Soils: Soil characteristics are one of the most important factors in determining the acceptability of a proposed land treatment site. Soils vary between predominantly clay soils with relatively low percolation rates to the sand-gravel types, with higher rates. The different rates are the result of the soil particle sizes and the spaces between them. Soils with the best combination of these factors are well-drained loams or sandy loams, for they would be capable of supporting good plant productivity. Factors of additional importance would be pH, salinity, nutrient levels, and adsorption and fixation capabilities of inorganic ions (EPA, March, 1975).

Factors that would be unfavorable for land treatment, according to R.L. Sanks, T. Asano and A.H. Ferguson (1976), are listed below:

o slopes greater than 15 percent in forested areas and greater than 10 percent in grassland (under certain conditions there may be exceptions to these values depending on soil permeability and application).

- bedrock closer than three feet to the surface or extensive outcropping of bedrock.

- soils that swell more than 30 percent.

- infiltration rates that are either extremely low or SAR values that are high.

- water table closer than three feet to the surface during the spraying season (EPA suggests a minimum of five feet or adequate under-drains).

- highly saline soils or highly saline wastewater.

- excessive boron or copper in the wastewater.

- several barely acceptable characteristics listed above, which in combination indicate an unsuitable site.

The soils to be treated near Aspen are displayed in Table II-1 of Chapter II, Other Existing Environments; all of them are currently being irrigated, even though some of them have severe slope limitations. These types include mapping units 28E, 29F, 32E, 55E, and 70E; their slopes exceed the recommended 10 percent gradient. Other soil types in the study area have permeability rates as low as 0.1 inch per hour and could allow for excessive overland flow during irrigation; they include 46D, 156D, 170C, and 170D. If the Aspen land treatment option is chosen, these types should be monitored by the managing agency. Runoff that is not treated by soil percolation could be detrimental to the water quality of the Roaring Fork River.

The soils to be treated in the Brush Creek basin are currently irrigated for agricultural and recreational purposes. Their characteristics are also displayed in Chapter II, Other Existing Environments. Three of these soils have permeabilities than can accommodate the planned application rates of two inches per week. They have soil permeabilities greater than that found for clay loams, which can accommodate 2.0 to 5.5 inches per week of overland flow (EPA, August 1973). Their combined acreage represents 120 of the 620 currently irrigated acres. The other 500 acres are found on soil type 146D, which ranges from clay to clay loam. This soil would be less able to accommodate two inches per week so it should be monitored for potential overflows into Brush Creek. If such flows should occur, application rates on that parcel of land should be reduced.

The Owl Creek soils are shown in Table III-3 of Chapter III. Soil types 56E and 93C could easily accept the recommended loading of two inches per week on their 138 acres. However, types 146C and 146D contain some clay and would be less able to accept this loading. If this alternative is chosen these soils should be watched for overland flow into Owl Creek. Another consideration for the Owl Creek soils is slope, which is greater than 10 percent for type 56E. It represents 85 of the 323 total acres that could be irrigated in this plan, and it should be considered as a marginal contributor.

The design engineer is recommending that current application rates be maintained for all agricultural lands and the Snowmass golf course. These rates translate into 3.0 acre-feet per acre per year for croplands and 2.5 acre-feet per year for the golf course, or two inches per week during the irrigation season. All three alternatives include additional lands for potential irrigation, in case these rates have to be reduced. The lands along Brush Creek provide over twice the acreage required for 1995. One and one-half the required 1995 land treatment area has been designated in the Owl Creek basin. For Aspen, three times the required treatment acreage is currently irrigated by the Salvation Ditch.

Another effect of land treatment involves the removal and retention of trace elements. These constituents are retained in most soils and their long-term accumulations can be toxic to plant life and soil micro-organisms. Toxic accumulations of many trace elements have been related to their concentrations in irrigation waters and the EPA has provided guidelines for their concentrations (Table IV-2). These constituents should be sampled in the study area's effluent to protect against trace element buildup, even though considered unlikely in this case.

Treatment Efficiency: Extensive investigations have been conducted during the past several years in an effort to identify the treatment efficiencies that might be expected from a well designed land treatment system. This information is now well documented (Pound and Crites, 1973; EPA, March 1975; and Sank and Asano, 1976) and is summarized in Table IV-3. As can be seen from this table, the overall renovation from a properly managed land treatment system is excellent. Removal of BOD, SS, N, P, trace metals, viruses and bacteria are all excellent and such a system should have no difficulty meeting the 1983 design goals as developed by the design engineer.

Nutrient Utilization by Vegetation: The effect of wastewater application to hay crops and cereal crops is almost always beneficial. Virtually all plant nutrients are found in wastewater and should stimulate plant growth. Their use should become increasingly important in view of the projected commercial fertilizer shortages and associated rising costs. Assuming a total nitrogen concentration of about 15 mg/ℓ in Snowmass's wastewater and an application rate of three acre-feet per acre per year, approximately 120 pounds per acre per year of nitrogen would be applied. This rate can be compared to fertilizer ranges for normal crops (Table IV-4), where it is found to be in the lower part of this range. Since these figures represent actual absorption by crops and not application rates, even more nitrogen is required. This is necessary because denitrifying bacteria in the soil can vaporize up to 40 percent of the applied nitrogen. Even if this loss is ignored, however, the proposed 120 pounds per acre is still less than the 275 pounds per acre, required by some local mixtures of fescue, brome and Timothy. Consequently, the proposed application rates should provide substantial nitrogen fertilizer without overloading the soil system. Whether additional nitrogen is required or not would depend on the crop.

The expected nitrogen output by the Aspen plant is 30 mg/ℓ, which translates into an application rate of 163 pounds per acre per year. This amount would be applied to the 1200 acres serviced by the Salvation Ditch. If it is used to fertilize alfalfa and meadow grasses, the rate should be acceptable. If it is applied to wheat or clover, it could be excessive. Thus, the use of wastewater for irrigation could alter cropping patterns in the area.

TABLE IV-2

RECOMMENDED MAXIMUM CONCENTRATIONS OF TRACE ELEMENTS IN IRRIGATION WATERS[a]

Element	For waters used continuously on all soil, mg/l	For use up to 20 years on fine-textured soils of pH 6.0 to 8.5, mg/l
Aluminum	5.0	20.1
Arsenic	0.10	2.0
Beryllium	0.10	9.50
Boron	0.75	2.0-10.0
Cadmium	0.010	0.050
Chromium	0.10	1.0
Cobalt	0.050	5.0
Copper	0.20	5.0
Fluoride	1.0	15.0
Iron	5.0	20.0
Lead	5.0	10.0
Lithium	2.5[b]	2.5[b]
Manganese	0.20	10.0
Molubdenum	0.010	0.050[c]
Nickel	0.20	2.0
Selenium	0.020	0.020
Zinc	2.0	10.0

[a] These levels will normally not adversely affect plants or soils. No data are available for mercury, silver, tin, titanium, tungsten.

[b] Recommended maximum concentration for irrigating citrus is 0.075 mg/l.

[c] For only acid fine-textured soils or acid soils with relatively high iron oxide contents.

TABLE IV-3

ESTIMATED PERCENTAGE RENOVATION EFFECTIVENESS OF LAND DISPOSAL TECHNIQUES

	Spray Irrigation	Overland Runoff	Rapid Infiltration Ponds
BOD	99	80	99
SS	99+	80	99
N	70-90	60-90	30-80
P	95-99	60-90	50-90
Trace metals	95-99	60-80	50-90
Organic toxicants	99	60-80	90
Viruses and bacteria	99+	90	99+
Cations	50-75	30-50	30-75
Anions	0-50	0-10	0-50

Effects of Nitrogen on Groundwater: Nitrogen contained in wastewater usually takes the form of organic nitrogen, ammonium-nitrogen, and nitrate-nitrogen, although organic and ammonium-nitrogen are the principal forms applied to the land. Organic nitrogen is usually present in suspended form and is filtered and decomposed into ammonium; ammonium-nitrogen is either vaporized or oxidized to nitrate-nitrogen. Nitrate-nitrogen is not retained in the soil but is either utilized as a crop nutrient, leached to the groundwater, or released as a gas following denitrification. The nitrates released to the groundwater are a potential hazard since concentrations in excess of 45 mg/ℓ can cause methemoglobanemia in small children. This potential hazard can be controlled by balancing the application rate with the natural removal rate of the plants (Table IV-4). Effecting such a balance could reduce the level of hydraulic loading and cause the irrigation of additional lands.

Effects of Trace Elements on Groundwater: Trace elements, heavy metals and refractory organics that are applied to soils are generally fixed in the soil particles and, in some cases, rendered nontoxic by bacteria. These constituents can be leached out of the soil, however, by excessive hydraulic loadings or by significant decreases in pH. Thus, adequate system management will be a necessary requirement. Tract metals should not be a problem since to industrial waste, contribution is apparent. However, a background check of groundwater quality is advised so a datum can be established for future reference.

Groundwater Recharge: Due to the low application rates that are proposed, recharge of groundwater aquifiers should be minimal. For the Brush Creek alternative, the amount should be on the order of six inches per year. After the effluent travels through the soil zone, it will travel horizontally towards the Creek. The potential horizontal movement will vary between 50 and 100 feet for the golf course and between 50 and 500 feet for the agricultural lands. This same movement ranges up to 2000 feet along Owl Creek and up to 5000 feet along the Roaring Fork River.

The groundwater tables are shallow along both creeks and the river; near Owl Creek this amounts to between two and three feet. The depth near Brush Creek is two feet, yet it increases to ten feet beyond the immediate vicinity of the creek. The depths to the groundwater are quite deep on the bench above the Roaring Fork River although they reduce to several feet near Woody Creek. As a result of some of these higher water tables, groundwater monitoring is recommended for nitrates.

Surface Water Runoff: Surface water runoff for a land treatment alternative could be created by excessive effluent irrigation and return flow. Overland flow or improperly designed spray irrigation return flow could enter the Roaring Fork River, Brush Creek or Owl Creek and could degrade their water quality. Such a possibility warrants monitoring, and if it is observed, application rates should be reduced. The other type of runoff would come from irrigation ditches and it could represent a significant

Table IV-4

Estimates of N and P_2O_5 Uptake by

Crops With Good Yields

Crops	N, lb/ac	P_2O_5, lb/ac
Corn	160	60
Wheat	70	30
Sugar Beets	150	60
Potatoes	225	80
Alfalfa and Grass	170	45
Clover	80	20

discharge source. It too, should be monitored and corrected if it is found to be occurring. Ways of correcting it would include reduction of application rates or recycling it back to the fields with a small pump.

Surface Water Storage: The planned storage reservoirs present potential odor problems during the spring although this is not expected to be significant. A more significant hazard would be the potential pollution of groundwater aquifiers, which would be especially true for nitrates. Consequently, the EPA recommends that the reservoirs are adequately sealed by a clay layer or sited so that groundwater seepage is minimal.

Public Health Considerations: The public health hazards associated with wastewater are caused by pathogenic bacteria, viruses, protozoa, worms and fungi. None of these are regularly analyzed although the hazard from pathogenic bacteria is identified indirectly, through the measurement of fecal coliforms or total coliforms. The fecal coliforms come almost entirely from the digestive tracts of humans and warm-blooded animals, while the total coliforms come from many other sources as well. The relationship between fecal coliforms and disease organisms has been substantiated for *Salmonella* (Geldreich, 1970; Geldreich and Bordner, 1971), where a high correlation was established between fecal coliforms and *Salmonella* when fecal coliforms densities exceeded 200 per 100 ml. Since the wastewater is to have less than this amount before land application, its content of *Salmonella* should be low. However, its content of other disease organisms cannot be predicted, but they too, may be low.

Viruses are more difficult to measure than bacteria but are also a potential health hazard. Research by Plotkin and Katz (1967) indicated that only one virulent virus is sufficient to infect a person if it contains susceptible cells. Also, Berg (1971) suggested that waterborne viral diseases need not occur at the epidemic level to be of significance. Infection could occur and not produce overt symptoms, and the infected individual could serve as a viral source for others. Although no large-scale spread of viral diseases is known to have occurred by the water pathway, a small outbreak has been reported that infected 800 people (Mosley, 1967). Viral diseases that could be transmitted by water include poliomyelitis, gastroenteritis and diarrhea; however, the most convincing evidence exists for infectious hepatitis.

Since most of the pathogens found in wastewater are from human sources, exotic pathogens may be of concern. Such organisms could come from foreign countries, transmitted by visitors to Aspen and Snowmass. However, the transmission of these organisms to susceptible people would be negligible for all the alternatives, except for those people that directly handle the wastewater. They would be in contact with aerosols that could contain an exotic disease organism but the possibility of infection would be slight.

Transmission of disease organisms can occur through groundwater percolation, crop contamination, or aerosol conveyance. The danger from percolation should be minimal since practically all bacteria and viruses are removed during passage through the first several inches of soil

(Pound and Crites, 1973; EPA, March 1975; and Spyridakas and Welch, 1976). Hazards from the pathogenic contamination of crops are a lesser known quantity, however. Crops slated for direct human consumption should not be irrigated with wastewater during the last month before harvest, especially vegetables. Other crops such as corn do not readily pick up and pass along intestinal bacteria but they could pick up other pathogens. Problems for grazing animals including the ingestion of parasites, are considered minimal.

The conveyance of pathogenic organisms via aerosols is a major concern on the Snowmass golf course and certain areas of the Salvation Ditch. Aerosols are simply droplets of liquid that have become airborne, and aerosols from municipal wastewaters do contain viruses and bacteria. The public health implications of these droplets have not been adequately examined in the field, but health hazards have been postulated. A lack of evidence for disease transmission by these aerosols divides professional opinion on the question.

If irrigation of the golf course is conducted when the course is not being used, then the potential danger from its aerosols should be reduced. Experience in other Colorado areas has shown that the application of wastewater to golf courses has produced no apparent ill effects (Dean, 1974). However, such a correlation is difficult to document since golfers being infected would be hard pressed to prove it. Spray irrigation on the benches northwest of Aspen occurs in a low-density area so its potential danger would also be reduced. Irrigation in both areas would be done in a macro-environment with a low humidity, which would minimize the distance traveled by an aerosol droplet. Also, the quantity of disease organisms would be reduced due to chlorination of the effluent before irrigation. None of these factors would eliminate the aerosol hazard but they would reduce it considerably.

Sludge Treatment and Disposal

The sludge treatment alternatives consist of different types of dewatering equipment in series with either aerobic or anaerobic digestion, plus different plans for disposal. All aspects of these alternatives are discussed under the headings of sludge treatment processes and sludge disposal.

Sludge Treatment Processes: The proposed dewatering systems include centrifugation, gravity thickening and dissolved air flotation. They are proven systems whose reliability is well documented. The centrifuge should obtain the greatest moisture removal of the three; however, it operates continuously at high rotational speeds and is more prone to maintenance problems.

As noted earlier, aerobic and anaerobic digestion are both acceptable stabilizing processes. Aerobic digestion is currently used at Aspen, it is easier to operate, and is less sensitive to upset; however, it does have a high power demand. Anaerobic digestion attains a more complete pathogen elimination and is the only acceptable alternative for those treatment schemes that use primary clarification.

Both centrifugation and vacuum filtration are proposed for the final dewatering step, prior to transport to the disposal site. Both equipment should provide acceptable service for this application. Centrifugation would require an organic polymer addition to facilitate the desired solids removal. Vacuum filtration, on the other hand, would require the chemical conditioning of the sludges to facilitate a successful filtration step. Chemicals used for this service could include alum, lime, ferric chloride and organic polymers. They would increase the dry sludge to be handled, while the polymer additives would not. Since the chemical additions are required for both centrifuging and vacuum filtration, both dewatering alternatives represent a long-term resource requirement.

Alternative 1 would transport the digested sludge to the disposal site at about six percent solids. Alternatives 3 and 4 use centrifugation or filtration, where the sludge cake would be transported to the site at 16 to 20 percent solids. Therefore, approximately one-third as many trips to the disposal site would be required, an obvious advantage.

Another transportation alternative (2) would involve the pumping of a 2 to 3 percent solids slurry to the site via a pipeline. In this instance the cost and maintenance of the final dewatering step is bypassed. The plans for the exact operation of the disposal site for this alternative would differ from the trenching procedures previously mentioned. Application would be by flooding and the soil and sludge would not be mixed during the winter months. During the summer months, the excess water would percolate into the soil, while the rest would be collected in the runoff collection basin at the south end of the site.

Sludge Disposal: The Aspen Metropolitan Sanitation District currently operates an ultimate wastewater sludge disposal facility on a 50-acre site near Woody Creek. The Aspen 201 Facilities Plan, Volume 1, proposed to continue this operation in future years. In addition, the Snowmass Facilities Plan recommends that the Snowmass District establish a working agreement with Aspen in this regard, so the existing site could be utilized for the disposal of sludges from both communities. The goal of the sludge disposal operation is to effectively dispose of stabilized sludges and realize a beneficial use of the sludge nutrient value. The mode of transport for the Aspen Districts would be either by trucking or pipeline. The Snowmass sludges would be trucked to the site. Maximum application rates would be 15 dry tons of sludge per acre per year; this loading would be less in earlier years of the project.

Three basic types of sludges could be produced in the project treatment plants; sludge from primary clarifiers, waste activated sludge and nitrification sludge. Typical digested sludge, especially waste activated sludge, does contain nitrogen, phosphorus and other plant nutrients. Thus, there is a definite beneficial impact for the soil and for any associated crops, when this sludge is applied to the land. The organic matter accompanying this sludge also increases the friability and the tilth of the upper layers of soil. It is eventually decomposed to a fairly stable, innocuous end product, which is a primary benefit of the process.

The negative impact on soils from sludge spreading is the possible accumulation of toxic metals. Monitoring data from the Denver sludge drying and farming facility indicate significant cumulative increases in metal concentrations since the project was started in 1971 (Schwing and Puntnney, 1974). Heavy metal concentrations are more likely to occur in sludge application than in secondary effluent applications since metals do tend to concentrate in the sludge. Application rates can, of course, be controlled so that the long-term accumulation of metals does not occur. Consequently, a trace element analysis of the sludges is recommended to assure that the recommended rate is acceptable.

Irrigation techniques will have to be practiced if the disposal site land is to be able to positively utilize the applied nutrients. A high fertilization application program on dry land would likely do more harm than good to crop production efforts.

If application rates are too high or if excessive irrigation is practiced, nitrates could be leached into the groundwater. Nitrates are soluble in water and not actively bound up by the soil particles. The amount of nitrate-nitrogen that could enter the groundwater can be controlled by balancing the crop uptake with the nitrogen applied in the sludge. The potential for nitrate contamination at the Aspen-Snowmass site is minimized by two factors. First, the site is located on the east terrace of the Roaring Fork River; depth to groundwater is about 40 feet and percolation rates to groundwater are slow. Lysimeters have been installed at two different depths around the site and no leachate percolation has been detected to date. Second, the proposed application rate is a maximum of 15 dry tons per acre per year. This is an acceptable application rate for nitrates in that as the sludges are mixed with the soil, a high percentage of the ammonia will be volatilized and released to the atmosphere. Organic nitrogen will be broken down and released for fertilizer at a slow rate. Consequently, the overall nitrate groundwater contamination potential at the Aspen-Snowmass site is judged to be minimal.

The impact of sludge application on surface water runoff can at times be significant if surface spreading and mixing techniques are employed. If high heavy metal and phosphate concentrations in the soils should develop in later years of application, runoff from high intensity storms could scour and carry some of these metals to the surface drainage bodies. The net impact of surface runoff from the Aspen site should be negligible, however, since all runoff is to be collected in a special collection basin. If the sludge pipeline from the Aspen Metro Plant is the chosen alternative, this collection basin must be evaluated and sized to accomodate the excess water runoff.

The environmental impact of sludge spreading on public health is not currently considered serious. Fears of contamination of surface water and groundwater by pathogens and virus are largely unfounded, especially when anaerobically digested sludge is applied. Crop uptake of disease-transmitting organisms is generally not considered to be a problem except in cases such as edible vegetables. The uptake and subsequent concentration of heavy metals by plants and foraging animals is also a concern that is currently raised. Tests on sludges from the Metro Chicago area indicated that potentially toxic metals were not absorbed into the plant structure (EPA Selected Abstracts, 1974).

In conclusion, the proposed disposal plan represents a beneficial use of an available resource. The large number of boulders on the site will tend to inhibit any intensive farming although the sludges should have a net beneficial effect on the soils. Potential problems associated with groundwater contamination, surface water runoff and public health considerations are not judged to be serious. Monitoring stations have been provided and any collected percolate should be analyzed. Additional monitoring should be done on the trace elements of the sludge so that the proposed application rates can be verified. Operating problems noted during the first year of operation have been corrected and vegetation growth should be initiated during 1976.

GEOLOGY

If in-plant processes are chosen for Aspen or Snowmass, or if no action is taken, the impact on the area's geology should be negligible. If the land treatment alternatives are chosen, impact could accrue to the water in the alluvium or the sedimentary layers. These possibilities are discussed in the previous evaluation of water quality. Although existing plants are in floodplains*, hazard is considered minimal because the present facilities and those proposed are designed for flood potential. In addition, the plant sites are relatively close to stream headwaters which limits the cumulative risk from flooding tributaries.

SOILS

The soils of the project area would receive significant impact only if one of the land treatment alternatives is chosen. Major impacts could result from salt loading or heavy metal buildups although this possibility depends on application rates. If land treatment is chosen, yearly water samples should be taken and analyzed for all the parameters of Table V-2 of the water quality evaluation.

BIOLOGY

The principal impacts on the area's biological systems would be on Brush Creek and the Roaring Fork River, no matter which alternative is chosen. The worst case would be the no-action alternative where point and nonpoint sources would continue to increase in the years ahead. Sources of concern would be the point discharges of ammonia and residual chlorine, discussed in the previous chapter on Other Existing Environment, Biology Section. The other sources would be nonpoint discharges, which would produce many of the same constituents found in sewage effluent.

The in-plant schemes would reduce the point discharges in the years ahead but not the nonpoint ones. Such sources could increase their impact on Brush Creek and the Roaring Fork River. Brush Creek has had a good brook trout and brown trout fishery for many years. It was good before the development of Snowmass resort, even though it had high natural turbidity (Gerbaz, 1975). Yet, the organisms in this stream have their limits so it should be monitored for biological changes by the Colorado Division of Wildlife.

---

*No reoccurance frequency has been established by the Corps of Engineers or USGS for streams in the study areas.

The most sensitive fish of the project area is the Colorado cutthroat trout (*Salmo clarki pleuriticus*). It is deemed a rare species by the U.S. Fish and Wildlife Service and occurs in the Roaring Fork basin. Its population should be protected in streams where it is known to occur, like Nickleson and Cunningham Creeks. The Colorado Division of Wildlife would be responsible for accomplishing this task.

If any of the land treatment plans are implemented, some minor impacts could accrue to the terrestrial environment. Hazards to domestic livestock are related to concentrations of trace elements in their forage crops. Since the effluent is not expected to contain high levels of these elements, it is not expected to be a problem. The effects on wildlife should be slight for the same reasons, although the potential improvement in crop productivity would be beneficial to some species of birds. Increases in local insect populations should also be slight if application rates are adjusted to minimize surface pooling and runoff.

All species that are deemed rare or endangered by the U.S. Fish and Wildlife Service could be adversely impacted by increased human activity, particularly in the back country. The proposed facilities will facilitate this situation in a limited sense through accommodating more people in the Roaring Fork Valley (see Population and Growth discussion of this Chapter).

CLIMATOLOGY AND AIR QUALITY

The climate of the study area does not allow a reliable year-round land treatment program. Although experimental programs have been used in similar cold climates, costs for land, operation and maintenance and public reaction combine to eliminate this even from alternative consideration. A related technique would store effluent in reservoirs for summertime application (Alternatives I/D and III/I) which would be more compatible with the climate; however, cost as discussed in the following section, makes these less desirable alternatives. Therefore, land treatment is only practical for summer application of summer effluent.

Study Area Plants: The construction of the Aspen Metro Plant has evidently provided tolerable odor conditions in the area of the ASD (Mill Street) Plant. However, the logical safeguard against future odor complaints would be to retire this plant as soon as possible, with corresponding expansion at the Metro Plant. The in-plant secondary and tertiary systems will not create odor problems under normal conditions and the remote location of the Metro plant provides ample land buffer even during upset conditions.

The location of the Snowmass Plant has not resulted in odor complaints and additional facilities should not change this situation.

As is the case for Aspen Metro, little air quality distinction can be drawn between in-plant secondary and tertiary treatment alternatives. The concept of spray irrigation with secondary effluent stimulates some concern for odor drift to nearby residences. Without local meteorological data for Snowmass, prevailing down-valley conditions might be assumed for daytime. This assumption of diurnal air motion suggests that up-valley conditions would occur at night, thus carrying any resultant odors in the direction of the community. As a precaution, irrigation, if selected, should be limited to daytime with the installation and use of a wind direction device to govern the spraying program.

Perhaps the most important consideration that must be given to a spray irrigation program is the potential for pathogenic aerosols. Spray nozzles, particularly high pressure, release small water droplets less than 50 microns in size. The higher the pressure the smaller the droplet (aerosol) and the longer the travel distance. Distances can be controlled by nozzle size, trajectory and pressure. In one study, bacteria traveled 460 to 530 feet with a 6.7 mph wind. Estimates of 100 to 1300 were associated with 11 mph winds, with most of the bacteria falling out within half the maximum measured distance (Sepp, E., 1971).

Therefore, EPA has determined that summer daytime spray irrigation would be compatible with the climate at Snowmass. However, this alternative must provide for low pressure nozzles aimed downward and the planting of suitable tree screens in areas adjacent to nearby residents.

Sludge disposal as proposed, involves a combination of in-plant digestion, thickening and trucking, or pumping to the present site. Assuming that the sludge will be adequately digested, no odor problems are envisioned, however, thickening and trucking is preferable. Pumped sludge even when digested and slurry water can create odor problems once spread at the site, while trucked sludge applied in trenches minimizes this potential.

LAND USE

In Chapter II (Other Existing Environments), a projection of what growth will occur and where, shows that only the ASD (Mill Street) Plant represents a conflict with desired future land use. This plant is too near the community and does not offer the odor and aesthetic safeguard of a land buffer. The proposition of early retirement should be encouraged in the case of this plant. The remaining two plants are situated so that they seem to complement apparent land use trends. Therefore, the in-plant alternatives do not have land use implications.

Land treatment not only provides a means of ammonia treatment and nutrient reuse, it preserves planned open space and thus affects future land use. Ideally, candidate treatment sites shown in Study Map 3 would be judged in relation to a comprehensive plan and the reality of acquiring necessary acreage. Unfortunately such a plan does not exist and the prospects of buying or leasing land on a long-term basis seem bleak due to land values. Although undeveloped land has been downzoned to essentially agricultural use, acquisition of necessary land would undoubtedly involve extremely high costs regardless of zoning designation. As a result, the only land which presently can be considered a realistic candidate for land treatment is the existing golf courses and open public land. For Snowmass this supports the concept of summertime land treatment on the golf course in combination with in-plant nitrification capability. A similar approach for Aspen Metro is desirable, however, cooperation of the members of the Salvation Ditch would be necessary which would require the long-term use of private land for treatment. Wright-McLaughlin personnel recently met with Salvation Ditch members who expressed significant reluctance to the long-term commitment of their land for this purpose. This is consistent with land value speculation and the suppressed desire to ultimately develop open land. EPA acknowledges the need for in-plant nitrification, while at the same time encourages the Aspen Metro District to pursue a summertime land treatment program not only for nutrient reuse and maintenance of flow in the Roaring Fork, but also for the preservation of agricultural open space.

POPULATION AND GROWTH

Earlier, in discussing population and land use (Section III), it was pointed out that the Aspen community had reached a widespread concensus on the need for controlling growth and for directing its location. It would be dysfunctional and undesirable to expand urban services that substantially exceed anticipated growth patterns and encourage a greater rate of development. The proposed 1977 expansions of the Snowmass and Aspen Metro wastewater treatment plants must be scrutinised to determine their growth impacts.

The proposed 1977 expansion of the Snowmass plant from 0.8 to 1.6 mgd is necessary to accommodate planned growth in Snowmass. County officials accept the need for controlled growth in Snowmass and are channeling much of the natural growth pressure within the Roaring Fork valley towards Snowmass. As Figure X (population projections, Snowmass Water and Sanitation District Study Area) indicates, growth in Snowmass is expected to continue and perhaps accelerate between 1979 and 1985, whereas growth will be controlled more severely through various land use constraints elsewhere in the Aspen area. The Snowmass wastewater plant expansion will allow growth to continue as planned, but not stimulate or encourage it. The planned growth, approved by County officials, is necessary for the economic well-being of the Snowmass resort and the Snowmass Water and Sanitation District. The District in particular, has assumed a substantial bonded indebtedness with a schedule of escalating payments. The financial stability of the District would be threatened, and present property owners would face excessive property tax levies, if growth did not continue as planned. Thus, the proposed expansion of the Snowmass plant cannot be viewed as causing undesirable growth impacts.

The proposed 1977 expansion of the Aspen Metro plant, from 2.0 to 3.0 mgd, will coincide with the abandonment of the old Mill Street wastewater treatment facility. The closing of the Mill Street plant is publicly viewed as a desirable outcome, eliminating an environmental nuisance. The Aspen Metro expansion, net of the loss of Mill Street treatment capacity, is not excessive for the anticipated growth of Aspen and its immediate surrounding area. Such growth is carefully controlled through street zoning and land use controls. Pitkin County has, earlier in

1976, adopted the Weiner & Associates population forecasts as the County's planning figures. This population growth (see Figure J, Population Projections, Aspen/Metro Sanitation District Study Area) will be accommodated by the proposed expansion. Yet, the expanded capacity does not appear to be a stimulus to unwanted growth. No new interceptor sewers are planned, which often serve to stimulate growth in new areas of Aspen.

In summary, the proposed 1977 expansion of the Snowmass and Aspen Metro facilities appear compatible with the controlled growth plans of the Aspen/Snowmass community. The treatment plants are designed to accommodate growth for the foreseeable future. However, their expansion does not appear to violate policies on controlled growth and land use. Expansion occurs at two existing treatment plant sites, rather than at new sites. A third existing treatment plant site (Mill Street) will be abandoned, and replaced by the expansion of the existing Aspen Metro plant. Finally, no new sewer interceptor lines are planned, which avoids one form of growth stimulus. Growth and land use issues have not been left unresolved in the wastewater treatment planning process.

Secondary Impacts

As previously discussed, the new sewage facilities will accommodate inevitable growth in Aspen and required growth in Snowmass. Associated with this growth will be deterioration of air quality through more fireplace emissions, road dust, and motor vehicle emissions. Noise, traffic, congestion and other adverse conditions will also intensify as the upper Roaring Fork Valley becomes more crowded. EPA cannot make the land use and transportation decisions which will minimize these future impacts. Such decisions must be made at a local level with support from state and federal agencies. EPA feels it has exercised this support responsibility by developing realistic population forecasts for planning future wastewater facilities.

COSTS

Now that the alternatives have been evaluated in terms of the natural environment, population and land use, the discussion turns to alternative costs, which is of concern to study area residents. The Facilities Plans prepared by Wright-McLaughlin Engineers (WME), present cost-effective analyses for required secondary and tertiary treatment steps. In the discussion that follows, WME's analyses are summarized.

Aspen

The Facilities Plan for Aspen and Aspen Metro devotes a great deal of analysis to secondary treatment and sludge disposal options. The overall approach is expansion of the activated sludge process at the Aspen Metro plant with sub-options for primary clarification and the use of pure oxygen to enhance efficiency. Tables VIII-A and VIII-B of the Facilities Plan indicate a cost preference for the secondary sub-alternative using secondary clarification and conventional aeration with sludge centrifuging, aerobic digestion and trucking to the existing disposal site (WME: ST-1a, STD-1).

The estimated costs for advanced tertiary treatment are compared in Table IV-5 which is taken from WME's Table VIII-C. It is evident that rotating bio-discs and trickling filters are very close in cost. A present worth

Table IV-5

COST COMPARISON OF ADVANCED WASTE TREATMENT ALTERNATIVES

Alternatives		Estimated Cost*	
		Capital	Operation & Maintenance
A. Activated sludge nitrification (WME, AT-1)		$2,260,000	$118,000/yr
Aeration Basins & Clarifiers	$1,810,000		
Filtration	400,000		
Chlorination	40,000		
Dechlorination	10,000		
B. Rotating bio-discs (WME, AT-2)		1,610,000	111,000/yr
Rotating bio-disc Facilities	1,160,000		
Filtration	400,000		
Chlorination	40,000		
Dechlorination	10,000		
C. Trickling Filter (WME, AT-4)		1,230,000	109,000/yr
Plastic Media Trickling Filters	780,000		
Filtration	400,000		
Chlorination	40,000		
Dechlorination	10,000		
D. Land Treatment (WME, AT-7)		2,650,000	176,000/yr
Reservoir	1,760,000		
Summer Pumping Station & Reservoir	220,000		
Pumping Station at Plant	220,000		
Filtration	400,000		
Chlorination	40,000		
Dechlorination	10,000		

*At ultimate size, using 1976 dollar levels. Includes 1977 and 1990 construction phases.

comparison, which includes the time value of money, shows that over the 20-year study period both in-plant treatment systems are similar in cost ($1.07 million for bio-discs and $0.895 million for trickling filter) in present worth dollars. Although trickling filters are estimated to be slightly cheaper, both options should be kept in consideration until such time that firm construction bids are received. Because the estimates are close, actual bid comparison would offer an accurate comparison from which to choose for detail design (Step 2).

Using trickling filters for comparison purposes, WME then summarized the financial impact of 1977 retirement of the ASD plant. In their Table IX-B, WME calculates the following 20-year total secondary, tertiary and sludge treatment costs:

Alternative	Present Worth Cost
II/C/1 = Expanded secondary activated sludge; trickling filter nitrification, multi-media filtration, chlorination and dechlorination; centrifuge and truck sludge; retire ASD in 1977.	$6,257,000
I/C/1* = Same as above except ASD is retained until 1990 and standards are not met.	$6,010,000

---

*As stated earlier, this approach will not comply with water quality standards and therefore is not acceptable to EPA.

Finally, use of the Salvation Ditch during the summer for land treatment, Alternative II/E/1 (winter in-plant, no storage) was compared to year-round in-plant treatment. In this case, summertime land treatment is estimated to be slightly more expensive (38,000) in present worth dollars. However, EPA prefers this approach because of the numerous advantages discussed previously.

Snowmass

For Snowmass, expansion of the present activated sludge process is the only cost-effective alternative for secondary treatment according to the Facilities Plan. For tertiary treatment, a combination of in-plant treatment in the winter and land treatment (golf course) in the summer has the economic advantage as also shown in Table IV-6. Here again, the cost of effluent storage for critical, non-irrigating months eliminates the feasibility of an ammonia treatment process totally reliant on land application.

WME determined in its present worth analysis that, as is the case for Aspen Metro, trickling filters and bio-discs are very close in cost. Therefore, they are recommending retaining both options until detail engineering (Step 2). Required treatment levels during summer months are more stringent and therefore the use of land treatment on the golf course is necessary. Alternative III/J/4 which offers both in-plant and golf course capability is also found to be the most cost-effective alternative.

TABLE IV-6

SNOWMASS ALTERNATIVE COST COMPARISON

Snowmass Alternatives[1]	Present Worth Cost (in millions)[2]
III/F/4 - Activated sludge for secondary and tertiary nitrification; multi-media filtration, chlorination and dechlorination; centrifuge and truck sludge. (WME - 2A)	3.170
III/G/4 - Same as III/F/4 except bio-discs tertiary nitrification (WME - 2C)	3.016
III/H/4 - Same as III/F/4 except trickling filter nitrification. (Breakpoint chlorination $115,000 addition to figure shown). (WME - 2B1 and 2B2 respectively)	3.017
III/I/4 - Same as III/F/4 except land treatment with reservoirs used for all tertiary treatment:	
o within Brush Creek basin (WME-1)	3.300
o in Owl Creek basin (WME-3)	3.402
III/J/4 - Same as III/G/4 with summertime land treatment on golf course (WME - 2D	3.007

---

1 Twenty-five percent contingency included in estimated costs.

2 Interest figured @ 6-1/8% over 20 year planning period.

It should be pointed out that WRE has advised the districts in both study areas that the cost-effectiveness of nitrification may be of marginal benefit to the receiving streams. Ammonia control will cost approximately $1,000,000 and $600,000 for Aspen Metro and Snowmass respectively. WRE contends that this money would be of greater benefit to the streams if used for nonpoint source control. EPA agrees that nonpoint source control is necessary in these study areas, however ammonia limits have been established to protect the stream aquatic life, therefore it is necessary to comply with the intent of the Act.

__Financial Impact on Districts__: A logical question follows: Can the districts afford to comply even with federal matching funds? To be analytical in answering, income and expenses (including this project) must be considered over the next 20-year period. Present worth can also be employed, however, projecting future income for the districts requires numerous assumptions including future assessed property valuations, service fees and interest from refunded bond payments and escrow accounts and a certain degree of crystal ball gazing. Like any projection, the results are only as good as the assumptions. Therefore the EIS study team made conservative valuation estimates based on the recent work of Larry Simmons (__Aspen Times__, April 8, 1976), the population forecasts discussed in Chapter II, and assumed present service fees prevailed for the long-term. Table IV-7 displays an estimate of revenues compared to the present worth of debt services, and total capital, operation, and maintenance costs. Interest income from refunded bonds is not considered in this comparison because of the difficulty in projecting these monies. The numbers themselves are not as important as the relation of revenues to costs over the long-term. According to this comparison, it is apparent that the districts can afford their share of capital costs (with federal participation) and annual costs over the long term. However, some form of shorter term financing will probably be necessary for initial capital cost outlays, particularly in the case of Snowmass.

Whereas Aspen and Aspen Metro are in sound financial condition and could sustain this expense even with less growth than projected, Snowmass must maintain a reasonable rate of growth and will have a substantial financial burden over the next 11 years in particular to meet debt service payment as well as increased costs associated with this 201 project. In both study areas federal 201 funding is warranted since the districts have the capability of financing their corresponding shares.

CITIZEN PREFERENCE

An extensive effort has been made by EPA to reflect local opinion throughout this EIS. Using citizen interviews, phone and written correspondence, and numerous public presentations, the study team has relied heavily on citizen input in all topics, with particular emphasis in the population and land use sections. The districts have organized Citizen Advisory Committees (CAC) which have aided in the designation of alternatives. These committees have met periodically, but have acted primarily in a "sounding board" capacity and have not been active in alternative evaluation or selection.

In the Aspen study area, the CAC members maintain that:

TABLE IV - 7

PROJECT EXPENSE AND DISTRICT REVENUE COMPARISON

	Aspen & Aspen Metro (present worth)	Snowmass (present worth)
Expenses		
Total Capital and O&M costs[1]	$6,295,000	$3,007,000
Total Debt Service	1,216,300	4,192,350
Total Gross Expenses	$7,511,300	$7,199,350
Income		
Property Tax Revenue	5,387,000	5,378,000
Service & Other	6,858,000	3,997,000
Total Gross Income	$12,245,000	$9,375,000

---

[1] District actual cost @ 25% with 75% 201 Grant.

1. Agency water quality goals be attained.
2. The excellent quality of the Roaring Fork be preserved.
3. Minimum flow be maintained at all times in the river.
4. Urban runoff should be controlled.
5. The ASD (Mill Street) Plant be retired as soon as possible.
6. Slowed growth policies will not adversely affect the financial condition of the districts.
7. Future capacities must be consistent with citizen land use and growth desires.

Although the CAC has not formerly considered and recommended an alternative, Alternative I, which retires the ASD Plant, seems to be a clear preference. Likewise, Alternatives IV and V which use in-plant nitrification processes, seem most desirable because of cost considerations and in conjunction with summertime land treatment would help maintain minimum flow.

The Snowmass CAC has met in a similar capacity as Aspen's. Members are keenly aware of the sensitive financial condition of the district and are in clear preference of cost-effective measures. Alternatives XI and XII most clearly satisfy this goal as well as agency water quality criteria. They are also concerned that wastewater facilities are planned with staged capacity which will not hinder growth which is both acceptable to the County and sufficient to maintain the financial prosperity of the Snowmass Resort area.

V.

RECOMMENDED ACTION

The Facilities Plans recommend the following alternatives for control of point source discharges:

ASPEN STUDY AREA

I/E/1 - This calls for the retirement of the ASD plant in 1977 with same-year expansion at the AMSD plant from 2.0 to 3.0 mgd. Secondary treatment will be provided by an expanded activated sludge process using secondary clarification. Tertiary treatment will be achieved by means of a trickling filter or bio-disc nitrification process and mixed media filtration for solids. The residual chlorine control method is an unresolved technical issue. The exact process will be determined and reported in the final EIS.

Sludge treatment will be provided by an aerobic digester with plant site centrifuging. Secondary and tertiary sludges once treated will be trucked to the existing disposal site where they will be deposited in shallow trenches which will be maintained,covered and revegetated as planned. Wright-McLaughlin also recommends the negotiated use of the Salvation Ditch for summertime land treatment. Although slightly more expensive than year-round in-plant treatment, this approach will have significantly beneficial effects, thus warranting the marginal increase in project cost. Construction phasing for this alternative is shown in Figure O. Major construction would occur in 1977 and 1990.

SNOWMASS STUDY AREA

III/J/4 - This alternative expands in 1977 the existing plant from 0.8 to 1.6 mgd. Activated sludge will remain the secondary treatment method while tertiary processes include bio-disc or trickling filter nitrification and mixed media filtration. As in the case of Aspen, the residual chlorine control method recommended by Wright-McLaughlin is questioned by EPA staff. This issue will be resolved prior to issuance of the final EIS. Summertime land treatment will also be necessary for advanced treatment.

Treatment limits are more stringent at this time due to the seasonal variability of ammonia toxicity. Figure P shows the major construction associated with this alternative.

Sludge treatment will be accomplished much like Aspen Metro with the addition of gravity thickening. Agreement with Aspen Metro will be necessary for use of its disposal site.

As a result of the issues identified in this

Preceding page blank

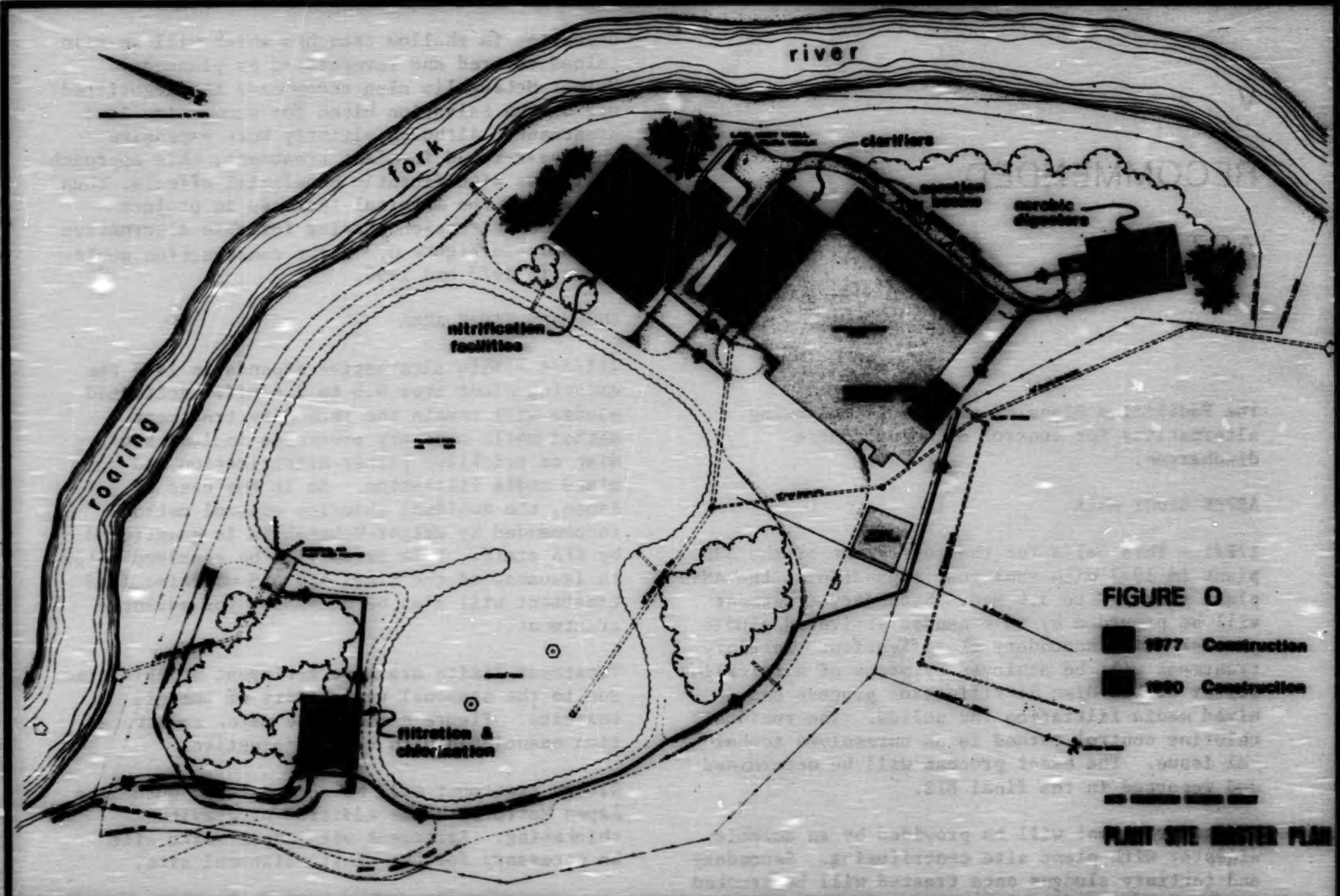

river
fork
roaring
clarifiers
aeration basins
aerobic digesters
nitrification facilities
filtration & chlorination
1977 Construction
1980 Construction

FIGURE O

PLANT SITE MASTER PLAN

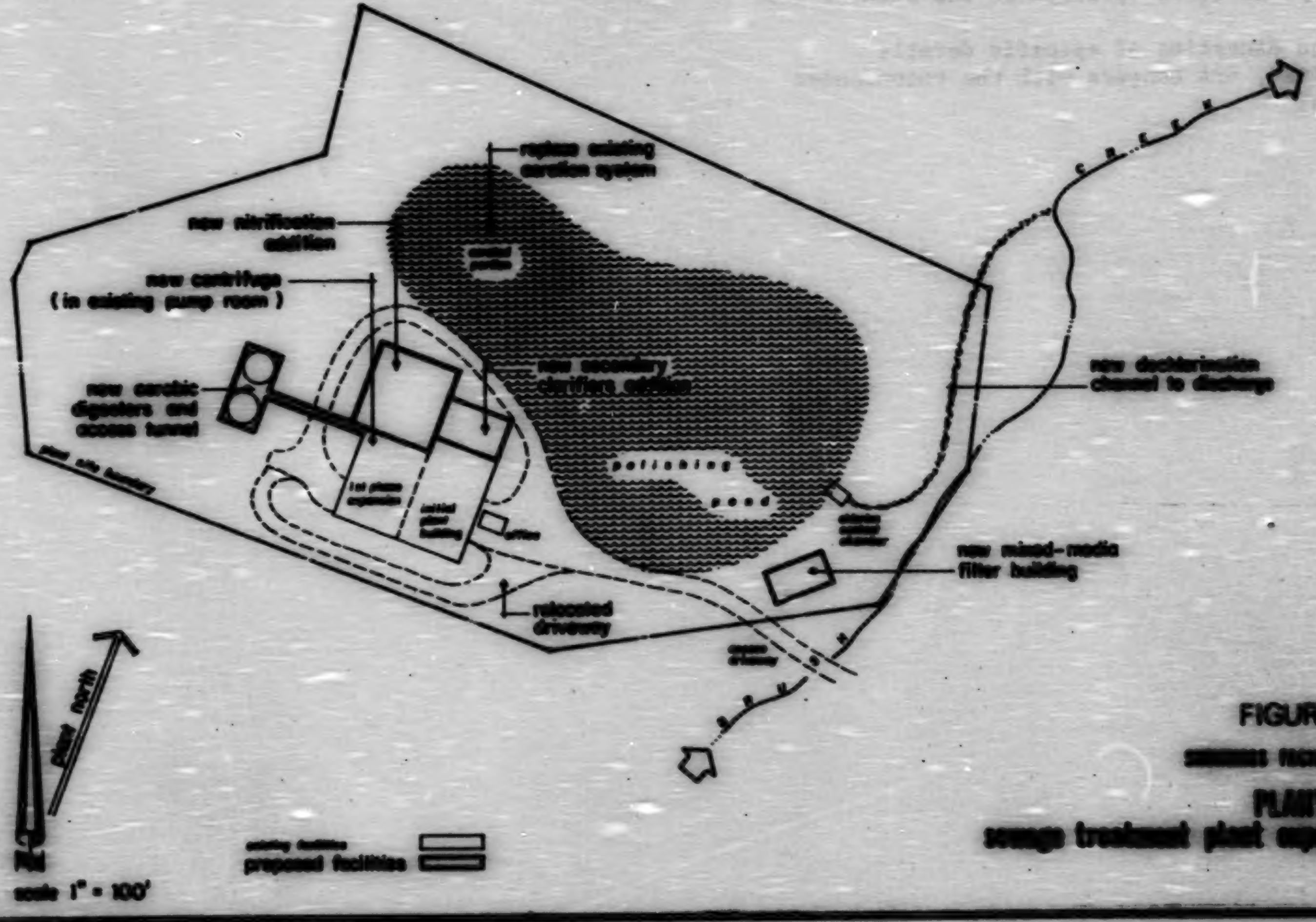

replace existing aeration system
new nitrification addition
new centrifuge
(in existing pump room)
new aerobic digesters and access tunnel
new secondary clarifiers addition
1st phase expansion
initial plant building
office
polishing pond
new dechlorination channel to discharge
new mixed-media filter building
relocated driveway
plant site boundary
C R E E K
plant north
MN
existing facilities
proposed facilities
scale 1" = 100'

FIGURE P

[illegible] FACILITIES PLAN EPA 201

PLANT SITE LAYOUT

sewage treatment plant expansion / upgrade

draft EIS, EPA will request the district to meet with local and state personnel as well as the Snowmass Corporation and Snowmass Resort Association to develop plans which will control the nonpoint source problem in the study areas.

With the exception of specific details identified, EPA concurs with the recommended actions.

VI.

MITIGATION MEASURES

The proposed mitigation measures are discussed in the text that follows. They are designed to minimize the projected impacts that are delineated in Chapter IV, Evaluation of the Alternatives. They are discussed under the headings of water quantity, water quality, geology, soils, biology, air quality, history and archaeology. Implementation of the measures are discussed in the final section.

WATER QUANTITY

The most significant water quantity problem of the study area is the occasional low flow of the receiving waters. This problem could be mitigated if any of the land treatment alternatives are implemented. These alternatives would allow appropriated irrigation waters to stay in receiving waters, thus enhancing low flows. The resultant benefit for Aspen would be an increase in low flows between the Salvation Ditch inlet and the ASD plant, a stretch of about two miles. The resultant effect for Snowmass would be an increase in low flows between the sewage plant and the upstream inlet for Snowmass American Corporation, the owner of the golf course.

Another water quantity problem for the study area is excessive infiltration into the sewage collection systems. This infiltration occurs mainly during the spring and early summer, resulting from high water tables, cracked pipes and poorly-sealed joints. It is substantial in the older parts of Aspen, where measured amounts have been three times the acceptable levels. Consequently, the city of Aspen is mitigating this problem by implementing a rehabilitation program proposed by Wright-McLaughlin Engineers (Wright-McLaughlin Engineers, Dec. 1975). These efforts reduce the required capacity of the proposed facilities.

The infiltration into Snowmass's system has been over five times the amount normally desired. This amount has comprised 80 to 90 percent of spring sewage flows and represents a substantial problem (Wright-McLaughlin Engineers, Nov. 1975). A comprehensive program to control this problem has been recommended by Wright-McLaughlin and is designed to reduce the infiltration by 50 to 70 percent. Its implementation is expected and is part of the proposed facilities plan.

WATER QUALITY

The water quality of Brush Creek and the Roaring Fork River can be maintained and improved by implementing the recommended action and by controlling and treating urban and agricultural runoff. All of these factors are necessary if the 1983 goal of the Water Pollution Control Act is to be achieved. An important corollary to the recommended action is sound and alert management of the proposed systems. This factor would be especially important if land treatment is employed. Its implementation would require proper application rates so that aerobic soil conditions could be maintained and groundwaters could be protected. If the treated effluent is discharged into receiving waters, periodic monitoring would be required to see if it complies with permit stipulations. Periodic monitoring should also be done on groundwaters so that management could regularly assess this parameter and take corrective action if necessary.

During the non-irrigation period it would be necessary to monitor the quality of the effluent and it would be helpful to monitor the sludge. Parameters of concern for effluent include ammonia, residual chlorine, BOD and suspended solids; for sludge they include ammonia, nitrate, BOD and trace metals. The effluent concentrations must conform to a discharge permit while sludge concentrations do not. However, the constituents in the sludge will impact the application site so their quality should also be known. Such information would be helpful in finding the optimum application rate or the optimum application method.

Besides improving the sewage facilities, additional work is necessary to control agricultural and urban runoff. The control of agricultural runoff is the primary responsibility of the landowner, yet Pitkin County and the Soil Conservation Service could provide some helpful advice or assistance. The control of urban runoff is more of a city problem and at the printing of this report, remains an unresolved issue. The design engineer has stated that they could incorporate such controls into their design; yet, the details of such a plan are not formulated nor is it known who would pay for it.

GEOLOGY

The main potential impact in the geological realm is flood damage. This impact can be mitigated by flood-proofing with berms and purchasing flood-proofed equipment. Such action is planned for the Aspen Metro plant since it will be sited within the 100-year flood plain, projected by the U.S. Corps of Engineers. The Snowmass plant could be partially in such a plain so it will be supplied with flood-proofed equipment and its polishing pond will be surrounded by a berm.

SOILS

The soils of the project area could be impacted if land treatment is used, however, they will be impacted due to sludge application and construction of new facilities. The application of effluent and sludge should impart a beneficial effect to the soils if distribution rates are controlled, although the construction of the new facilities will provide local conditions for erosion. When foundations are laid, they should be performed during the drier periods of the year to mitigate against the loss of top soils. Soils that are disturbed from this action should be stockpiled and saved for revegetation activities.

BIOLOGY

The biological systems most affected by the project are Brush Creek and the Roaring Fork River, proposed irrigation and sludge disposal sites, and the construction site. The means of mitigating impacts on the receiving waters and the farmlands have already been discussed. The means of mitigating the impact on the construction site is to implement an effective revegetation program. Topsoil will be saved during grading, if possible, and stockpiled for later distribution. Seeding should be done preceding the first growing season and should be supplemented with fertilizer and irrigation. An attempt should be made to accomplish this with the naturally-fertilized effluent. The initial planting should be with annuals, to be followed by perennials, once establishment becomes evident. Consultation with the local Soil Conservation Service and the University of Colorado Extension Service could be helpful in determining the most suitable species to plant.

AIR QUALITY

The proposed 1977 retirement of the ASD plant is preferable because it would mitigate periodic odor problems associated with this plant. Care must be exercised in the continued use of the Aspen Metro sludge disposal site. The recent handling improvements and proposed additions should mitigate odor problems of the past, but proper supervision will be necessary to insure against future odor problems.

HISTORY AND ARCHAEOLOGY

If archaeological artifacts are discovered during construction or plowing activities, these activities will be stopped. A qualified archaeologist will then be summoned to investigate the site. If the findings are significant, accommodations will be made to allow proper excavation and assessment. However, these accommodations will be done in such a manner that construction delays are minimized.

CONCLUSION

Implementation of many of the detailed mitigating measures will depend upon subsequent approval of the final version of the engineer's Facility Plan. This plan will analyze what is cost-effective for the SSRSA and the details of soil replacement, revegetation, and land application operation, etc. In addition, comments received as a result of reviewing this draft EIS recommending additional mitigating measures will be incorporated into the design of this treatment plant if possible. The final EIS will detail the mitigating measures that will be implemented as a result of agency and public review.

VII.

UNAVOIDABLE ADVERSE EFFECTS

After the impacts of the recommended action are mitigated, the remaining impacts are considered unavoidable. These impacts would accrue mainly to the area's water quality and are considered minor. Although effluent outputs of BOD, suspended solids, ammonia and residual chlorine should decrease, the output of nitrates could increase. This constituent is a nutrient that can be used by aquatic plants and could promote a fertilizing effect on the receiving waters. The resultant effect should be beneficial, by increasing the productivity of the waters' aquatic plants, aquatic insects and fish; however, excessive amounts of nitrates could be harmful. These amounts have not been determined by EPA and await further research.

Other unavoidable impacts include the loss of several acres of undeveloped land due to structural additions to the existing plants. Impacts associated with the land application program are expected to be beneficial, and its potential adverse impacts should be avoidable through proper application rates and proper management.

VIII.

SHORT TERM USES AND LONG TERM PRODUCTIVITY

The short-term uses of the study area are centered around tourism and recreation. The proposed Facilities Plan provides support for these activities and strive to do it in an environmentally sound manner. It should benefit the productivity of local croplands if effluent and sludge are properly applied to them. However, when the effluent is discharged into Brush Creek or the Roaring Fork River some degradation in water quality could result, even though most of it would represent an improvement over existing conditions. These effluents could also improve the productivity of the river's ecosystem, by fertilizing with organics, ammonia and nitrate.

After 20 or 30 years, the productivity of the area's croplands could be enhanced by the application of sewage wastes. However, the productivity of Brush Creek and the Roaring Fork River could deteriorate, if other sources of pollution are not checked, like urban and agricultural runoff. These sources affect the short-term productivity of receiving waters although they could degrade it even more in the future. Urban runoff should increase more than the others and special considerations should be given to controlling and treating it. The output of agricultural runoff should be relatively constant unless new techniques can be developed to reduce it. The overall impact could be a long-term reduction in aquatic productivity.

IX.

IRREVERSIBLE & IRRETRIEVABLE COMMITMENT OF RESOURCES

Despite the improvements in environmental quality that the recommended action would provide, certain resources would be required to implement it. These resources would include raw materials to build the plant and its distribution system: steel, concrete, plastic, glass, etc. Most of this material would represent an irreversible and irretrievable commitment of resources although future improvements in recycling technology could enable some of it to be reclaimed and reused. Other resources would include various types of energy, necessary to build and operate the system. These resources would be irretrievable once they are used.

The land would represent another resource committed to the project. Those lands under irrigation could be committed for the duration of the project, after which they could be returned to their current use. However, the quality of these lands could be irreversibly altered by the proposed irrigation practices, even though this is expected to be beneficial. Those lands used by the plant should not be irreversibly committed since future reclamation activities could restore most of their productivity.

The condition of Brush Creek and the Roaring Fork River will be altered by the increased sewage load to be discharged into it. This change could be beneficial if the discharged nutrients promote an increase in the river's productivity. However, future changes in sewage treatment could alter these conditions so it is only irreversible throughout the lifetime of the proposed facilities.

BIBLIOGRAPHY

Army, Department of the, Corps of Engineers. 1974. Flood Plain Information, Roaring Fork River above Aspen, Colorado.

Aspen Area General Plan - Final Report, 1966.

Aspen Chamber and Visitors Bureau, Aspen Area Map and Merchants Listing.

Aspen, City of. Inventory of Aspen Clubs and Organizations.

________. Inventory of Existing Parks and Recreation Facilities in Aspen.

________. Map of Aspen, Colorado Annexations.

________. Ordinance No. 11, "Zoning," published in the Aspen Times, March 13, 1975.

________. 1974. Planning and Zoning Commission, Recommended Zoning Code, Recodification of Chapter 24, Aspen Municipal Code.

________. Zoning District Map, Aspen, Colorado.

Aspen Land Use Plan, July 1973.

Aspen Planning Office. April 1975. Build-Out on Under-Utilized Land Under Code Adopted by City Council.

Aspen Times, The and Aspen Today, February 13, 1975 to January 1, 1976 (for The Aspen Times).

Audubon. March 1976. Will the Bald Eagle Survive to 2076. National Audubon Society, New York, New York, pp. 99-101.

Berg, G. 1971. Integrated Approach to Problem of Viruses. J. Sanit. Eng. Div. Amer. Soc. Civil Eng. 97(SA6): 867-882.

Citizens Bus Alternative Committee, The. August 13, 1975. Bus Alternative Study, Aspen.

Citizens Transit Design Committee. July 30, 1975. Light Rail Transit System for Pitkin County, Community Criteria and Recommendations for Final Design, Aspen.

Colorado Department of Health. 1974. "The Air Pollution Carrying Capacity of Selected Colorado Mountain Valley Ski Communities."

Colorado Division of Wildlife et al. 1974. Upper Roaring Fork Environmental Impact Study.

Colorado Health Department. August 1974. Pitkin County Air Quality Impact Report.

Colorado State Archeologist's Office, Letter, June 25, 1975.

Dean, R.J. 1974. Land Application of Effluents in the Rocky Mountain Prairie Region. Masters Thesis, University of Colorado, Boulder, Colorado.

Design Workshop Inc. 1975. A Process for Establishing Alternatives to the Automobile, A Preliminary Draft. Aspen.

Geldreich, E.E. 1970. Applying Bacteriological Parameters to Recreational Water Quality. J. Amer. Water Works Assn. 62(2): 113-120.

Geldreich, E.E. and R.H. Bordner. 1971. Fecal Contamination of Fruits and Vegetables During Cultivation and Processing for Market. A Review. J. Milk Food Technol. 34(4): 184-195.

Gilmore, John S. and Mary K. Duff. March 1974. The Evolving Economy of Pitkin County: Growth Management by Consensus in a Boom Community. Denver: Denver Research Institute, Denver, Colorado.

Goals Task Force. July 1971. Tentative Objectives.

Goeldner, C.R. 1974. The Aspen Skier, Volumes I and II (Lift Survey and Lodging Survey, respectively). Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, Colorado.

Halprin, H. Lawrence & Associates. June 1975. Colorado State Highway 82, Design Concept Study. San Francisco, California.

Hem, John D. 1970. Study and Interpretation of the Chemical Characteristics of Natural Water. U.S. Government Printing Office, Washington, D.C.

Isbill Associates. 1973. Environmental Impact Assessment Report: Aspen-Pitkin County Airport, Aspen, Colorado.

Lautenback, W.E.; M.D. McAnnelly; D. Pendleton; T. Shepherd; and T.L. Trembly. 1974. Environmental Resources Analysis for Pitkin County, a Tool for Planning. Colorado State University, Fort Collins, Colorado.

London, C.C. July 1975. Quality Skiing at Aspen, Colorado: A Study in Recreational Carrying Capacity, Institute of Arctic and Alpine Research, University of Colorado, Boulder, Colorado.

Marlatt, W. November 1974. An Analysis of the Air Pollution Potential of the Owl Creek Valley, Pitkin County Colorado.

Master Plan Revision Committee. April 1974. Recommendations for Land Use in Pitkin County.

Metcalf and Eddy, Inc. 1972. Wastewater Engineering. McGraw Hill, New York. 782 pp.

Mosley, J.W. 1967. Transmission of Viral Diseases by Drinking Water, in Transmission of Viruses by the Water Route (ed) G. Berg. Interscience Publishers, Inc., New York. pp. 5-23.

Nobe, et al. 1975. A Survey of Sportsmen Expenditures for Hunting and Fishing in Colorado, 1973.

Pitkin County. Abstracts of Assessments and Levies, 1973, 1974.

Pitkin County Subdivision Analysis, A COFE Project, May 1973.

Pitkin County, Board of County Commissioners. March 1974. Resolution 74-16 (Zoning Resolution and Map Amendments).

________. Pitkin County Zoning Resolution, amended January 10, 1975.

Plotkin, S.A. and M. Katz. 1967. Minimal Infective Doses of Viruses for Man by the Oral Route, in Transmission of Viruses by the Water Route (ed.) G. Berg. Interscience Publishers, Inc., New York, p. 151.

Pound, C.E. and R.W. Crites. July 1973. Characteristics of Municipal Effluents. Proceedings of the Joint Conference on Recycling Municipal Sludges and Effluents on Land. Champaign, University of Illinois, pp. 49-62.

Rocky Mountain News, Denver, December 19, 1975.

Shellman, Dwight. June 1975. Proposed Performance Criteria for Development in Pitkin County—An Abstract.

Simmons, Larry and Harold Stalf. September 1975. The Aspen Employee Survey, Summer-1975. Office of the Urban Economist, Aspen, Colorado.

Simmons, Larry. June 1975. Fiscal Impact of Annexation.

________. June 1975. Ski-Lift Pricing—An Economic Overview.

Sullivan, R.H. et al. July 1973. Survey of Facilities Using Land Application of Wastewater. Office of Water Program Operations, EPA, Washington, D.C.

Summer, David. July 1973. Aspen Area Urbanization, A Case Study on Environmental Impacts. Thorne Ecological Institute, Boulder, Colorado.

THK Associates, Inc. October 1974. The Impacts of Alternative Development Patterns for the Snowmass Corporation Properties.

________. 1975. A Study of the Feasibility of Incorporating the Snowmass Resort Area.

U.S. Department of Transportation. September 30, 1974. Procedures for Considering Environmental Impacts. Office of the Secretary. Washington, D.C.

U.S. Environmental Protection Agency. 1973. Methods to Control Pollution Resulting From Construction Activities. Washington, D.C.

________. March 1973. Water Quality Criteria 1972. U.S. Government Printing Office, Washington, D.C.

________. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health.

________. 1974. Joint Construction Sediment Control Project.

________. 1975. Formation of Halogenated Organics by Chlorination of Water Supplies.

________. March, 1975. Evaluation of Land Application Systems. EPA-430/9 - 75-001, Washington, D.C.

________. 1976. Quality Criteria for Water. To be published.

U.S. Federal Register. March 14, 1975. EPA. Interim Primary Drinking Water Standards.

Voorhees, Alan M. & Associates. July 1973. Regional Transportation Plan for the City of Aspen and Pitkin County. Denver, Colorado.

Wallace, McHarg, Roberts and Todd. October 1974. Owl Creek, A Feasibility Study for Future Development. Philadelphia, Penn.

Weiner & Associates Inc. January 1976. Preliminary Environmental Impact Analysis of the Proposed Pitkin County Light Rail Transit System. Denver, Colorado

Wright-McLaughlin Engineers. May 1974. Roaring Fork River Basin Water Quality Management Plan. Denver, Colorado

________. November 1975. Wastewater Management Report for Snowmass Water and Sanitation District, 201 Facilities Plan, volume 1. Denver, Colorado.

________. December 1975. Wastewater Management Plan, Aspen Metro Sanitation District, Aspen, Colorado, 201 Facilities Plan, volume 1. Denver, Colorado

________. May 1976. Wastewater Management Plan, Aspen Metro Sanitation District, Aspen, Colorado, 201 Facilities Plan, volume 2. Denver, Colorado

________. May 1976. Wastewater Management Report for Snowmass Water and Sanitation District, 201 Facilities Plan, volume 2. Denver, Colorado.

Appendix A

Water Quality Standards and Regulations

TABLE A-I

STREAM QUALITY DESIGNATION

Standard	Meaning
A1, A2, B1, B2	Suitable as a raw water supply treatable to drinking water standards
A1, B1	Cold water fishery (DO = 6 mg/l, Temp. 68° F)
A2, B2	Warm water fishery (DO = 5 mg/l, Temp. 90° F)
A1, A2	Suitable for all purposes for which raw water is customarily used including primary contact recreation (Fecal Coli = 200/100 ml, pH = 6.5-8.5)
B1, B2	Suitable for all purposes for which raw water is customarily used except primary contact recreation (Fecal Coli = 1000/100 ml, pH = 6-9).

TABLE A-II

WATER QUALITY STANDARDS SUMMARY

Standard	Class			
	A_1	A_2	B_1	B_2
Settleable Solids	Free From	Free From	Free From	Free From
Floating Solids	Free From	Free From	Free From	Free From
Taste, Odor, Color	Free From	Free From	Free From	Free From
Toxic Materials	Free From	Free From	Free From	Free From
Oil and Grease	Cause a film or Other discoloration	Cause a film or other discoloration	Cause a film or other discoloration	Cause a film or other discoloration
Radioactive Material	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards
Fecal Coliform Bacteria	Geometric Mean of <200/100 ml from five samples in 30-day per.	Geometric Mean of <200/100 ml from five samples in 30-day per.	Geometric Mean of <1000/100 ml from five samples in 30-day per.	Geometric Mean of <1000/100 ml from five samples in 30-day per.
Turbidity	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.
Dissolved Oxygen	6 mg/l minimum	5 mg/l minimum	6 mg/l minimum	5 mg/l minimum
pH	6.5-8.5	6.5-8.5	6.0-9.0	6.0-9.0
Temperature	Maximum 68°F Maximum Change 2°F	Maximum 90°F Maximum Change: Streams - 5°F Lakes - 3°F	Maximum 68°F Maximum Change 2°F	Maximum 90°F Maximum Change: Streams - 5°F Lakes - 3°F
Fecal Streptococcus	Monthly average of <20/100 ml from five samples in 30-day per.	Monthly average of <20/100 ml from five samples in 30-day per.	--	--

TABLE A-III

COLORADO STANDARDS FOR THE DISCHARGE OF WASTES

	Parameter Limitation, Effective August 21, 1975	
Parameter	**7-Day Average**	**30-Day Average**
BOD$_5$	45 mg/1	30 mg/1
Suspended Solid	45 mg/1	30 mg/1
Fecal Coliform	As determined by the Division of Administration of the State Health Department to protect public health in the stream classification to which the discharge is made.	
Residual Chlorine	Less than 0.5 mg/1	
pH	6.0 - 9.0	
Oil and Grease	10 mg/1 and there shall be no visible sheen.	

TABLE A-IV

Proposed Variable Discharge Standards For Ammonia-Nitrogen[1]

Season	Aspen Metro 1978	Aspen Metro 1983	Snowmass 1978	Snowmass 1983
January	40	30 mg/1	3.47	2.29
February	34	25	3.41	2.13
March	27	20	2.85	2.02
April	47	36	2.88	1.18
May	38	29	2.97	2.43
June	89	72	8.25	4.85
July	24	18	3.54	1.98
August	12	9	1.53	0.89
September	18	13	3.2	1.84
October	16	12	2.68	1.48
November	42	33	2.32	1.36
December	52	39	3.99	2.51

---

[1] These levels are designed to protect fish life although future permit standards could be less, to be equal to or less than existing performance records (Tables I-16 and I-18).

TABLE A-V

ASPEN METRO SANITATION DISTRICT
SANITARY SEWAGE EFFLUENT QUALITY CRITERIA
Wright-McLaughlin Engineers

Constituent	Average Natural Background Level*		Treatment Plant Influent	Effluent Limitations 1			Comments
	(a)	(b)		1978	1983/BPT	1985/NDCP	
OXYGEN DEMAND							
Biochemical Oxygen Demand	0.4 mg/l	0.7 mg/l	248 mg/l	22 mg/l	13 mg/l (464 lb/day)	10 mg/l	1978 & 1983 - Consistent with 303 Basin Plan and NPDES permit allocation of 464 lb/day and population loads. 1985 - compatible with "no discharge of critical pollutants"
Chemical Oxygen Demand					25 mg/l	20 mg/l	1983 & 1985 - Compatible with BOD removal
Dissolved Oxygen	8.6 mg/l	8.4 mg/l		> 7.5 mg/l	>7.5 mg/l	> 7.5 mg/l	1978, 1983 & 1985 - Required to comply with 303 Basin Plan recommendations.
SOLIDS							
Suspended Solids	2 mg/l	2 mg/l	220 mg/l	22 mg/l	13 mg/l (464 lb/day)	10 mg/l	1978 - Required by NPDES permit 1983 - Compatible with BOD removal & 303 Basin Plan 1985 - Compatible with no discharge of critical pollutants
Settleable Solids			8.1 mg/l		Free From	Free From	1983 & 1985 - State stream standard requirement
Total Dissolved Solids	49 mg/l				500-1000 mg/l	500-1000 mg/l	1985 - Required for agricultural irrigation of sensitive crops
PHYSICAL CHARACTERISTICS							
Temperature			54°F		±1°C of ambient	±1°C of ambient	1983 & 1985 - state stream standard requirement. parameter involved with ammonia (probably not critical requirement)
Color					Free From	Free From	1983 & 1985 - state stream standard requirement
Turbidity	9.6 JTU	1.4 JTU				10 JTU	1985 - desirable limit
CHEMICAL CHARACTERISTICS							
pH	8.0	7.9	7.4	6.0-9.0	6.5-8.3	6.5-8.3	1985 - acceptable quality for recreational water. critical parameters involved with ammonia
Alkalinity					30-130 mg/l	30-130 mg/l	1985 - probable limits
Chlorine				.05 mg/l	.05 mg/l	.05 mg/l	1978, 1983 & 1985 - limit compatible with limits of detectability for chlorine.
MICROORGANISMS							
Fecal Coliform	$< \frac{200}{100\ ml}$	$< \frac{200}{100\ ml}$		$\frac{200}{100\ ml}$	$\frac{200}{100\ ml}$	$\frac{200}{100\ ml}$	1978 - Required by NPDES permit 1985 - limit required for recreational waters
Viruses							Goal is absence of viruses. No test data

TABLE : . Cont.

Constituent	Average Natural Background Level[2] (a)	(b)	Treatment Plant Influent	Effluent Limitations 1978	1983/BPT	1985/NDCP	Comments
ORGANICS							
Pesticides					.07 96 hr LC 50	.01 96 hr. LC 50	1985 - Limit required to support aquatic life 1983 - Assimilative capacity utilized
Phenols					.007 mg/l	.001 mg/l	1985 - Limit required for public water supply 1983 - Assimilative capacity utilized
Oils & Greases				10 mg/l	.35 96 hr LC 50	.05 96 hr LC 50	1985 - Limit required to support aquatic life. 1983 - Assimilative Capacity utilized
MACRO NUTRIENTS							
Ammonia N (NH_3-N)	.05 mg/l	97 mg/l	23 mg/l	- - - See Table A-IV - - -			Un-ionized ammonia above 0.02 mg/l may be toxic to aquatic life. Table A-IV shows the allowable NH_3-N in plant effluent based on the stream temperature, pH and flow and on the quantity of effluent.
Phosphorus			7 mg/l				
OTHER CONSTITUENTS							
Micro Nutrients Metals							1983 & 1985 - Should be consistent with "Proposed Criteria for Water Quality, Volume 1," EPA, 1973 Not stated here individually.

Average water quality data reported by the Colorado Department of Health for a May through September sampling period at a point approximately 2.5 miles upstream (a) and 8.5 miles upstream (b), of the U.S.G.S. Aspen gaging station on the Roaring Fork.

BPT - Best Practicable Treatment

NDCP - No Discharge of Critical Pollutants

96 Hr LC50 - Median Lethal Concentration - Concentration causes death to 50 percent of a population within 96 hours.

[1] EPA does not recognize these 1985 recommendations as official policy.

Wright-McLaughlin Engineers

TABLE A-VI

SNOWMASS WASTEWATER MANAGEMENT
FACILITIES PLAN
EFFLUENT LIMITATIONS

CONSTITUENT	RAW WATER SUPPLY	NATURAL BACKGROUND LEVEL		TREATMENT PLANT INFLUENT	EFFLUENT LIMITATIONS			RATIONALE (CONTROLLING USE)
		(a)	(b)	(c)	1978	(d) 1983/BPT	(e) 1985/HDCP	
OXYGEN DEMAND								
Biochemical Oxygen Demand		1.9 mg/l	2.9 mg/l		20 mg/l	15 mg/l	10 mg/l	1978 - Current State Standard; 1983 - Agrees with waste load allocation per Basin Plan and should not cause adverse oxygen demand or Brush Creek; 1985 - compatible with HDCP and should support ultimate population load.
Chemical Oxygen Demand		-	18 mg/l	-	-	30 mg/l	20 mg/l	Compatible with required BOD removal.
Dissolved Oxygen		7.9 mg/l	-	-	>7.5 mg/l	>7.5 mg/l	>7.5 mg/l	1978, 83, 85 - Required to comply with Roaring Fork Basin Plan.
SOLIDS								
Suspended Solids		32 mg/l	110 mg/l	51.0 mg/l	30 mg/l	20 mg/l	10 mg/l	1978 - Current State Standard; 1983 - Consistent with BOD removal and demand for fishable water in Pitkin County. This agrees with waste load allocation per Basin Plan; 1985 - compatible with HDCP and should support ultimate population load.
Settleable Solids		-	-	2.0 mg/l		Free from	Free from	1978 - Current State Stream Standards.
Total Dissolved Solids		280 mg/l	161 mg/l	-	-	500-1000 mg/l	500-1000 mg/l	1983 & 85 - TDS not critical. Effluent suitable for irrigation of golf course and additional irrigated lands. With irrigation same regime of return flow will be maintained.
PHYSICAL/CHEMICAL PARAMETERS								
Temperature		Varies 1-16°	-		-	No specific limit		1983 & 85 - Limit temperature change as required to support aquatic life.
pH		-	-		6 - 9	6.5-8.5	6.5-8.5	1978 - Current State Standard; 1983 & 85 - Acceptable quality for recreational water.
Turbidity		-	-			<10% change	in C.P.	1983 & 85 - Required to support aquatic life.
Color		-	-			Free from	Free from	1983 & 85 - Current State Stream Standards.
Alkalinity		-	-		-	30 - 130 mg/l	30 - 130mg/l	1983 & 85 - Required to support aquatic life and wildlife.
Chlorine		17	-		0.05 mg/l	0.05 mg/l	0.05 mg/l	1978,83,85 - Required by State Discharge Permit (Effective 9/1/76) Residual Chlorine
MICROORGANISM								
Fecal Coliform		200/100	-	$3.8 \times 10^{6}/100$	200/100	200/100	200/100	1978 - Required by State Discharge Permit (Effective 9/1/76) and EPA Standards; 1983 & 1985-required for full body contact recreation.
Viruses		-	-	-	-	-	0	Goal is absence of viruses - No test data available.
ORGANICS								
Pesticides		-	-		-	0.01 96 Hr. LC_{50}		1983 & 85 - limit required to support specific aquatic life.
Phenols		-	-		-	No limit given	0.001 mg/l	1985 - limit required for public water supply.
Oils & Greases					<10 mg/l	0.05 96 Hr. LC_{50}		1978 - Current State Standard; 1983 & 85-limit required to support aquatic life.
MACRO NUTRIENTS								
Total Nitrogen		-	-					No specific limit
Total Ammonia (NH_4 + NH_3)		3.2 mg/l	-		0.6 mg/l	See note		1978 - Required by State Discharge Permit (Effective 9/1/76); 1983 & 85 - See variable effluent limit which is a function of temperature, pH, and flow

Reproduced from best available copy.

Note: Recent tests upstream of plant indicate background levels of 3.0-3.5 mg/l of NO_3. Nonpoint source management plan calls for correction of nonpoint pollution.

Nitrate N		3.5			-			No specific limi;
Phosphorous		-	-		-			No specific limit
Potassium		-	0.1 mg/l		-	-	< 0.1	1985 - limit compatible with background level.
Sulfur(Sulfided)		-	-		-	0.002 mg/l	0.002 mg/l	1983 & 85 - limit required to support aquatic life.
Magnesium		-	>10 mg/l		-	No Limit	< 125 mg/l	1985 - recommended limit for public water supply.
MICRO NUTRIENTS								
Iron		-	2.0 mg/l		-	2.0 mg/l	0.3 mg/l	1983 - limit compatible with background level; 1985-limit required for public water supply.
Manganese		-	0.1 mg/l		-	0.20 mg/l	0.05 mg/l	1983 - limit required for agricultural irrigation; 1985-limit required for public water supply.
Boron		-	0.1 mg/l		-	1.0 mg/l	1.0 mg/l	1983 & 85 - limit required for semi-tolerant crops (agricultural irrigation) and public water supply.
Zinc		-	-		-	0.003 96 Hr. LC_{50}	0.003 96 Hr. LC_{50}	1983 & 85 - limit required to support aquatic life.
Copper		-	0.001 mg/l		-	0.1 96 Hr LC_{50}	0.1 96 Hr. LC_{50}	1983 & 85 - limit required to support aquatic life.
Molybdenum		-	-		-	0.01 mg/l	0.01 mg/l	1983 & 85 - limit required for agricultural irrigation water.
METALS								
Aluminum		-	2.0 mg/l		-	5.0 mg/l	2.0 mg/l	1983 - limit required for agricultural irrigation water; 1985-limit to comply with antidegradation policy.
Lead		-	-		-	0.03 mg/l	0.03 mg/l	1983 & 85 - limit required to support aquatic life.
Mercury		-	-		-	0.0002 mg/l	0.0002 mg/l	1983 & 85 - limit required for public water supply.
Chromium		-	0.0001 mg/l		-	0.03 mg/l	0.03 mg/l	1983 & 85 - limit required to support aquatic life.
Cadmium		-	-		-	0.03 mg/l (hardwater)	0.01 mg/l	1983 - limit required to support aquatic life; 1985-limit required for public water supply.
Nickel		-	-		- -	0.02 96 Hr. LC_{50}	0.02 96 Hr. LC_{50}	1983 & 85 - limit required to support aquatic life.

NOTES

(1) Brush Creek Stream Class: Water Quality Limited (subject to change)
(2) 7-day, 10-year Fall low flow = 1 cfs.
(3) 1973 Peak Day Discharge = 0.945 mgd = 1.461 cfs (no dilution effect at low flow).
(4) 1993 Peak Day Discharge = 1.35 mgd = 2.088 cfs (no dilution effect at low flow).
(5) Uses of Brush Creek water: Cold water fishery, Agricultural irrigation.
(6) Water Quality Criteria design point - just below Snowmass Sewage Treatment Plant.

(a) Water Quality Sampling by Colorado Department of Health, May-Sept. 1973 at Highway 82.
(b) Water Quality Sampling by Wright-McLaughlin Engineers, Snowmass Runoff Management Plan, at point C near Wood Road, March, 1974.
(c) From Sampling by Colorado Department of Health, 1972
(d) BPT = Best practicable waste treatment technology
(e) NDCP = No discharge of critical pollutants

EPA has not established official policy on 1985 standards, the numbers in this column are recommendations of Wright-McLaughlin Engineers

REFERENCES

(1) Proposed Water Quality Information, Vols. I & II, October 1973, U.S. Environmental Protection Agency, Washington, D. C.
(2) Results of sampling by Colorado Department of Health.
(3) Memorandum on Roaring Fork River Study, October 15-17, 1974, Colorado Department of Health, Water Quality Control Division.
(4) Water Quality Sampling by Wright-McLaughlin Engineers, Snowmass Runoff Management Plan, 1974.
(5) Water Quality Criteria, 2nd ed., McKee & Wolf, California State Water Resources Control Board, 1963.
(6) Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. Department of the Interior, 1968.

TABLE A-VII

ESTIMATED MUNICIPAL WASTEWATER POLLUTION LOADS--1975

Flow without 1/1 Removal		Flow with 50% 1/1 Removal			Estimated Municipal Loading	Municipal Loadings Based on 1974-75 Population without 1/1 Removal				Municipal Loadings Based on 1974-75 Population with 50% 1/1 Removal			
Peak Tourist	Peak 1/1	Peak Tourist	Peak 1/1			Peak Tourist		Peak 1/1		Peak Tourist		Peak 1/1	
mgd	mgd	mgd	mgd	Parameter	lbs/cap/day	lbs/day	mg/l	lbs/day	mg/l	lbs/day	mg/l	lbs/day	mg/l
0.62	1.06	0.52	0.56	BOD	0.17	882	170	127	14.4	882	204	127	27.3
				SS	0.18	934	180	134	15.1	934	216	134	29.0
				Org. N	0.0146	75.7	14.6	10.9	1.2	75.7	17.5	10.9	2.3
				NH_3-N	0.0097	50.3	9.7	7.2	0.8	50.3	11.6	7.2	1.5
				TP	0.0116	60.2	11.6	8.7	1.0	60.2	14.0	8.7	1.9

APPENDIX B

WASTE TREATMENT PROCESS REVIEW

The formal Section 201 Facilities Planning effort requires the development and evaluation of various alternative wastewater treatment schemes. These various alternative treatment schemes consist of different combinations of sewage treatment processes, which can be considered interconnected elements with different functions. In order to better understand these various functions, a brief review of treatment techniques is discussed in the text that follows. The organization includes the following sections: the identification of the most significant pollutants in the study area, a description of the different levels of treatment, and a description of currently accepted methods of sludge treatment and sludge disposal.

Significant Pollutants in the Wastewaters

Wastewater differs from high quality waters by the presence of one or more constituents, which are undesirable due to health factors, aesthetics physical, chemical, and biological factors. These factors can be identified as those constituents that tend to degrade the useful and aesthetic characteristics of the water medium. In the study area the five major parameters of concern are biochemical oxygen demand, inorganic and biological suspended solids. ammonia-nitrogen, residual chlorine and pathogenic organisms. Because of the significance of these parameters to overall wastewater quality and to any associated wastewater treatment facility, a working definition of each is provided next.

The biochemical oxygen demand (BOD) is the amount of oxygen required to stabilize organic matter present in a water via biological action. The BOD test is among the most important made in the wastewater analysis since the direct effect of BOD is a decrease in dissolved oxygen in the water. The maintenance of minimum oxygen levels is required to support stream fisheries and associated aquatic life, so the presence of BOD does have significant implications for overall water quality. The standard test for BOD requires five days of bacterial action and oxygen sampling and is called the 5-day BOD test.

Municipal wastewater also contains significant quantities of both inorganic and organic suspended solids (SS). These solids are important in at least two respects. First, approximately 25 to 40 percent of the biochemical oxygen demand is associated with suspended solids; therefore, if the SS are removed then a significant percentage of BOD is also removed. Second, solids create turbidity, and can settle out, creating sludge banks in receiving streambeds, cause odors and reduce biological productivity.

Ammonia-nitrogen is present in domestic wastewaters due to the biological breakdown of protein. Its significance in the study area is that the un-ionized form of this parameter is highly toxic to fish life. Since the maintenance of a high quality fishery is a stated goal of the State of Colorado and the 1972 Water

Pollution Control Act as Amended, an extensive investigation of this parameter was conducted by the design engineer. Advanced treatment for ammonia removal will be required to protect and enhance the Roaring Fork River fishery. However, if irrigation is used to develop tertiary treatment, this compound is considered the precursor of a very valuable nutrient, nitrate.

Chlorine is present in wastewaters due to its use as a disinfection medium. It can be toxic to aquatic life, depending on the concentrations of free chlorine and residual chlorine. Free chlorine is seldom present in a well-managed facility due to the combination of chlorine with the waste products. One of these combinations is called chloramine, which is a compound of chlorine and ammonia; it is quite toxic to fish and other aquatic life.

Pathogenic organisms consist basically of bacteria and viruses from human wastes, which are a health hazard to downstream water users. Their destruction or removal is desirable from an overall public health point of view. However, chlorination is not especially effective in removing viruses, so there awaits further research and improved technology.

Alternate Treatment Processes

There are three basic levels of waste treatment that can be attained via different combinations of treatment processes; these basic treatment levels include primary treatment, secondary treatment and advanced or tertiary treatment. The significance of each of these and the engineering processes used to attain them are discussed next.

Primary treatment is normally employed for the removal of floating materials or suspended solids, which also prepares the wastewater for the next treatment process. Pre-treatment provides for the removal of large materials, such as rags and boards, etc., that could damage pumps, plug lines or otherwise interfere with the satisfactory operation of the equipment. Heavy inorganic grit such as sand and gravel, which also lead to similar operations and maintenance problems throughout the plant, are also removed by the preliminary treatment apparatus. This apparatus generally consists of combinations of coarse screens, grinding and small settling chambers.

The primary treatment follows the pre-treatment and is accomplished by gravity settling via a large settling tank or clarifier, which removes suspended solids and biological oxygen demand. The settleable solids represent 50 to 65 percent of the total suspended matter and 25 to 40 percent of the BOD. Removal of the BOD in the primary settling tanks reduces the loading of the subsequent treatment units. Primary sludge collected at the bottom of the clarifier is usually disposed of by anaerobic rather than aerobic digestion, due to a superior pathogen removal.

Secondary treatment is the next treatment process; its purpose is to convert dissolved and suspended organic matter (BOD) to harmless gases, water and settleable solids, via biological processes. Disinfection is also generally considered a secondary treatment process. The two most frequently used biological processes are the trickling filter and the activated sludge systems.

The basic trickling filter consists of a circular concrete or steel structure packed with filter medium, which is usually crushed rock or synthetic materials. Wastewater is uniformly applied to the media by means of a rotating distributor and is collected and discharged at the bottom. Microorganisms grow on the surface of the rock media and consume the organic material in the wastewater. As they grow, they form a slime layer that periodically breaks off and is conveyed to a secondary clarifier. This clarifier settles out suspended material that has sloughed off the filter medium. The effluent is then recycled through the trickling filter, in an effort to improve the overall effluent quality. The advantage of trickling filters is their simplicity of operation and low sludge production. The main disadvantage is lower removal efficiencies and occasional odor problems. When cold ambient temperatures slow down the rate of biological activity, the removal efficiencies are reduced even more.

The other type of secondary treatment is called activated sludge although it comprises several types of processes. All these processes mix influent waste streams with biological floc in an aerated tank. The system consists of one or more aeration basins where air (or oxygen) is introduced by means of mechanical aerators (or diffusers). This aeration provides the oxygen to the microorganisms and maintains a properly mixed system. The aeration basins are followed in series by secondary clarifiers or sedimentation basins, where suspended microorganisms are settled out. A portion of these organisms are returned to the aeration basin to be mixed with new wastes; the excess organisms constitute waste sludge from the system and are sent to the sludge handling facilities. The conventional activated sludge system has a residence time in the aeration basin of five to eight hours. An extended aeration process utilizes a lower organic loading rate and uses a 24 to 36 hour retention time in the aeration basin. Primary clarification is generally not provided at the front of this process because longer residence time offers greater resistance to upset and less exacting requirements for operation control. BOD removals in the range of 80 percent should be achieved in activated sludge-extended aeration secondary treatment processes.

An alternative process to the extended aeration method is the rotating Bio-Disc, whose application is probably more extensive in Europe than in the U.S. This process consists of a series of large diameter plastic discs that are mounted on a horizontal shaft and placed in a contoured concrete tank. The discs are slowly rotated while approximately 40 percent of their surface area is immersed in the wastewater. Microorganisms adhere to the rotating surfaces in a fashion similar to that of the trickling filter. During rotation, the discs pick up a thin film of wastewater that flows down the surface and absorbs oxygen from the air. The microorganisms then consume the organic constituents from the thin film. A secondary clarifier is then required to remove material sloughed off the disc surfaces; however, recycling of this effluent is not required. Primary treatment is usually provided ahead of the Bio-Disc unit, creating a need for anaerobic digestion. BOD removals are comparable to that achieved with an activated sludge system.

Pathogen reduction for both activated sludge and trickling filters is accomplished by chlorination after secondary treatment has been completed. The success of this process is generally measured in terms of a fecal coliform count, or the number of coliforms per 100 ml. Current Colorado Discharge standards require a reduction of fecal coliform counts to less than 200 per 100 ml.

Until recently, the accepted practice in municipal wastewater processing has been secondary treatment, resulting in approximately 90 percent BOD reduction. With the advent of PL 92-500, however, it has become necessary to remove greater quantities of nitrogen, phosphorus, BOD and suspended solids. In the study area, the principal constituents of concern are SS, BOD and ammonia-nitrogen. The additional removal of these parameters can be achieved in two ways, by in-plant treatment or land treatment.

An in-plant advanced treatment scheme for Aspen or Snowmass would consist of the nitrification of ammonia and conversion to nitrate-nitrogen. This would be followed by filtration for suspended solids and BOD. Conventional biological nitrification is similar to the activated sludge system except a different type of microorganisms are maintained for the process. Both the Bio-Disc and trickling filter processes can be used for the nitrification step. With the Bio-Disc system an intermediate secondary clarification step is not required.

The nitrification process is temperature dependent so the colder winter temperatures of the area will reduce its efficiency of conversion. This characteristic makes it more difficult to start and maintain, which would require increased operator attention.

Another means of achieving tertiary treatment is irrigation, or land treatment. Irrigation, in this sense. would be construed as the controlled discharge of effluent by spraying or surface spreading to support plant growth and to treat the wastewater. Thus, instead of removing various constituents like nitrogen and phosphorus, they would be beneficially utilized by the crops. The land application technique uses the land and its associated biosystem somewhat as a living filter medium. Treatment is accomplished by a combination of physical, chemical and biological means, as the applied wastewater seeps into the soil. Many of the impurities that are entrapped in the soil are eventually used by the higher plants as a growth component, and the wastewater receives the equivalent to tertiary treatment.

The applicability of land treatment to a certain region depends on many factors. Some of the more significant criteria are as follows:

- o Climate — Warm-to-arid climates permit longer season application, but more severe climates are acceptable if adequate storage is provided for wet or freezing conditions.
- o Topography — Slopes up to 15 percent are acceptable for crop irrigation if runoff or erosion is controlled.
- o Soil type — Loamy soils are preferable, but most soils from sandy loams to clay loams are suitable.
- o Soil drainage — Well-drained soil is preferable, however, more poorly drained soils may be suitable if drainage features are included in the design.

- Soil depth — A uniform depth of 5 to 6 feet (1.52 to 1.83 m) or more is usually necessary throughout sites for root development and wastewater renovation.

- Geologic formations — Lack of discontinuities that could provide short circuits to the groundwater is necessary.

- Groundwater — A minimum depth of 5 feet (1.53 m) to ground water is normally necessary to maintain aerobic conditions, provide necessary renovation, and prevent surface waterlogging. Control may be obtained by underdrains or groundwater pumping.

These are not hard and fast requirements but they emphasize the need for consultation with soil and agricultural specialists during the design phases.

The most significant positive aspect of a land treatment system is that it represents the utilization of an available resource. The available nitrogen and phosphate in the wastewater would eliminate or reduce the need for chemical fertilizers. However, a successful land treatment operation will require constant effort, in the form of communication and cooperation between the municipality and the participating farmers.

Sludge Treatment and Disposal

Most of the treatment processes in the water pollution control field yield a sludge from either a settling process, a biological reaction, a filtration process or combinations of these. The solids undergo a series of treatment steps involving digestion, thickening and dewatering, prior to ultimate disposal.

Digestion is the process by which the organic fraction of the primary or wasted sludge is decomposed prior to final disposal. Both the anaerobic digestion (without oxygen) and the aerobic digestion (with oxygen) processes are applicable to typical wastewater sludges. Anaerobic digestion is probably more effective in reducing pathogen content and is sometimes required for certain primary sludges; however, it is fairly susceptible to upset conditions. Aerobic digesters are easier to operate and exhibit a lower capital cost, although they require higher operating costs due to supplying the required oxygen.

The dewatering of sludge reduces the moisture content of the digested sludge. When this content can be reduced by a factor of two or three, the cost of the ultimate disposal is greatly reduced through reduction in both weight and volume. Mechanical dewatering is usually achieved by vacuum filtration or centrifugation. Vacuum filtration uses a vacuum to pull or suck the moisture from the sludges. The centrifuge, on the other hand, concentrates sludges on the outside of a rotating unit, due to the centrifugal forces created by high rotating speeds. Depending on the nature of the sludges, the dewatering step could be preceded by sludge conditioning, with the addition of chemicals such as lime or organic polyelectrolytes.

In the land application option, the thickened and digested sludges would be used for their nutrient content near the treatment plant site. The nitrogen, phosphates, trace elements, and organic matter contained in the sludge are then utilized for plant growth and subsequent crop production. The presence of nitrogen and trace metals would determine the loading rates to be applied.

If a sanitary landfill option is chosen, dewatered sludge would be trucked to an acceptable sanitary landfill site where the sludges would be buried. The sanitary landfill operation would have to be a controlled disposal facility with adequate safeguards against leaching to groundwaters, potential odor problems and potential rodent problems.

A third means of disposal would involve the incineration of the sludge. This procedure would involve oxidation to an inert ash, probably via multiple hearth or fluid bed processes. Supplementary fuel oil is generally required in this process and the inert residual ash would be landfilled. The capital and operating costs of this option are high as compared to land treatment or sanitary landfill and compliance with State air quality regulations on a consistent basis is extremely difficult.

APPENDIX C

THE STATE HISTORICAL SOCIETY OF COLORADO
State Archaeologist, 5A Ketchum Bldg., University of Colorado, Boulder 80302

June 25, 1975

James Collier
Weiner Associates
1541 Dahlia
Denver, Colorado 80220

Dear Mr. Collier:

This letter is in response to your phone call of June 20, 1975 requesting information on archaeological resources at Aspen: Townships 10 & 9S, Ranges 85 &84 W. A file search has been done in the Colorado Archaeological Site Survey File maintained by this office.

The following sites are located within the defined area:

5 PT 55	Sec.5	T9S	R85W
5 PT 56	Sec.8	T9S	R85W

Because it is important to your statement on archaeological resources, it must be added that our files are incomplete. The Office of the State Archaeologist is building a master file on Colorado site information. It is being expanded to hopefully include site data from all agencies and institutions dealing with prehistoric Colorado materials, but this is far from being accomplished. At this time our records are not comprehensive and usually not representative of the variety of prehistoric materials present on an area.

The enclosed information includes what is in the files right now, but as time passes, the file will become more complete. When specific projects are contemplated, you should check back with this office to obtain the latest information.

Another important point is that this file holds records only on reported sites, sites referred to this office and previously to the University of Colorado Museum. Most areas of the state have not been systematically surveyed for prehistoric materials. The higher areas of the state are gradually revealing a significant, if low density of archaeological materials.

Also, a few reported sites from a county does not mean necessarily that there is only a little archaeological material in the area, only that there has been little reporting of such items. For this reason, the information in the files is a start, but it is basically an inadequate assessment of such resources. For specific projects, any really significant evaluation of archaeological resources has to be the result of a qualified person actually walking the area. Even then, surface indications are often insufficent for locating potentially important sites. Some buried cultural materials may only be revealed during the process of land alterations such as trenching, levelling, reseeding, arroyo cutting, etc. My primary concern is that these files might be mistaken to be a complete statement of such resources, for they certainly are not. Of course, the need for specific information differs with the various stages of planning.

In addition, other agencies concerned with your area, such as the Forest Service, Bureau of Land Management, etc. may have records of archaeological materials in their holdings. Local people and societies sometimes have information which is not available in the central records.

The enclosed site records are for land use planning purposes only. We are most anxious to cooperate with projects involved with impact statements, land use planning, inventories, etc. However, unfortunately, we are concerned that such detailed site locations not become a guide for irresponsible purposes. Irreparable archaeological damage could be done if this information led to the surface denudation or digging of sites by unauthorized, untrained persons. We trust you will appreciate the potential difficulties we face and will responsibly limit the circulation of the enclosed site information. If you feel uneasy about a request for access, feel free to refer the request to this office.

This office deals only with archaeological materials. For information regarding historical sites in your area, contact Cynthia Emrick, Preservation Assistant, State Historical Society of Colorado, 1880 Gaylord, Denver, Colorado (tele. 333-1672). This office, the Office of the State Archaeologist, is part of the State Historical Society. However, statements regarding cultural resources should include comments both from this office and Ms. Emrick's office.

Please contact me if I can be of further assistance. Our office phone is 449-0630 and we are located in Ketchum 5A at the University of Colorado campus in Boulder.

Sincerely,

Hannah Huse

Hannah Huse
Survey Archaeologist

THE STATE HISTORICAL SOCIETY OF COLORADO

State Archaeologist, 5A Ketchum Bldg., University of Colorado, Boulder 80302

June 25, 1975

James Collier
Weiner Associates
1541 Dahlia
Denver, Colorado 80220

Dear Mr. Collier:

This letter is in response to your phone call of June 20, 1974 requesting information on archaeological resources at Snowmass Townships 10 & 9S, Ranges 87 & 86W. A file search has been done in the Colorado Archaeological Site Survey File maintained by this office.

At this time there are no archaeological sites listed in this file which fall within the designated area.

Because it is important to your statement on archaeological resources, it must be added that our files are incomplete. The Office of the State Archaeologist is building a master file on Colorado site information. It is being expanded to hopefully include site data from all agencies and institutions dealing with prehistoric Colorado materials, but this is far from being accomplished. At this time our records are not comprehensive and usually not representative of the variety of prehistoric materials present in an area.

The enclosed information includes what is in the files right now, but as time passes, the file will become more complete. When specific projects are contemplated, you should check back with this office to obtain the latest information.

Another important point is that this file holds records only on reported sites, sites referred to this office and previously to the University of Colorado Museum. Most areas of the state have not been systematically surveyed for prehistoric materials. The higher areas of the state are gradually revealing a significant, if low density of archaeological materials.

Also, a few reported sites from a county does not mean necessarily that there is only a little archaeological material in the area, only that there has been little reporting of such items. For this reason, the information in the files is a start, but it is basically an inadequate assesment of such resources. For specific projects, any really significant evaluation of archaeological resources has to be the result of a qualified person actually walking the area. Even then, surface indications are often insufficient for locating potentially important sites. Some buried cultural materials may only be revealed during the process of land alterations such as trenching, levelling, reseeding, arroyo cutting, etc. My primary concern is that these files might be mistaken to be a complete statement of such resources, for they certainly are not. Of course, the need for specific information differs with the various stages of planning.

In addition, other agencies concerned with your area, such as the Forest Service, Bureau of Land Management, etc. may have records of archaeological materials in their holdings. Local people and societies sometimes have information which is not available in the central records.

This office deals only with archaeological materials. For information regarding historical sites in your area, contact Cynthia Emrick, Preservation Assistant, State Historical Society of Colorado, 188o Gaylord, Denver, Colorado (tele. 333-1672). This office, the Office of the State Archaeologist, is part of the State Historical Society. However, statements regarding cultural resources should include comments both from this office and from Ms. Emrick's office.

Please contact me if I can be of further assistance. Our office phone is 449-0630 and we are located in Ketchum Building, Room 5A at the University of Colorado campus in Boulder.

Sincerely,

Hannah Huse

Hannah Huse
Survey Archaeologist